

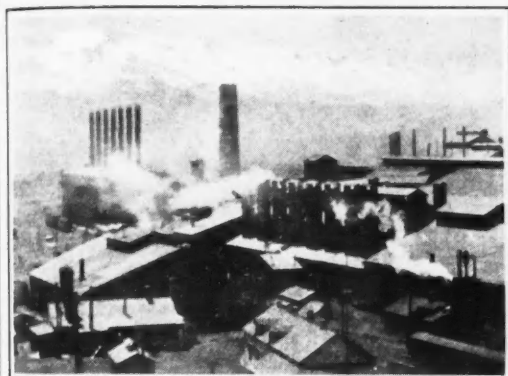
JUN 1 1925
May 30, 1925

McGraw Hill Company, Inc.

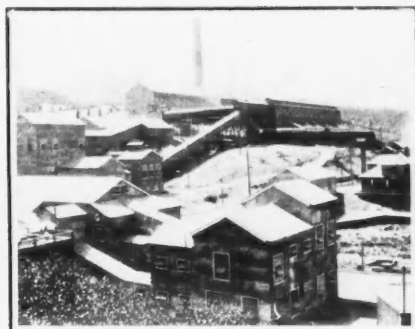
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ENGINEERING AND MINING JOURNAL-PRESS

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Arkansas Valley Smelter, Leadville, Col.



Bunker Hill & Sullivan Smelter, Kellogg, Idaho



Smelter at Murray, Utah

Notes on Western Lead Smelters

By Arthur B. Parsons

The Great Diamond Hoax

By T. A. Rickard

Preparing Briquetted Mineral Grains for Microscopic Study

By R. E. Head

A New Continuous Thickener and Clarifier

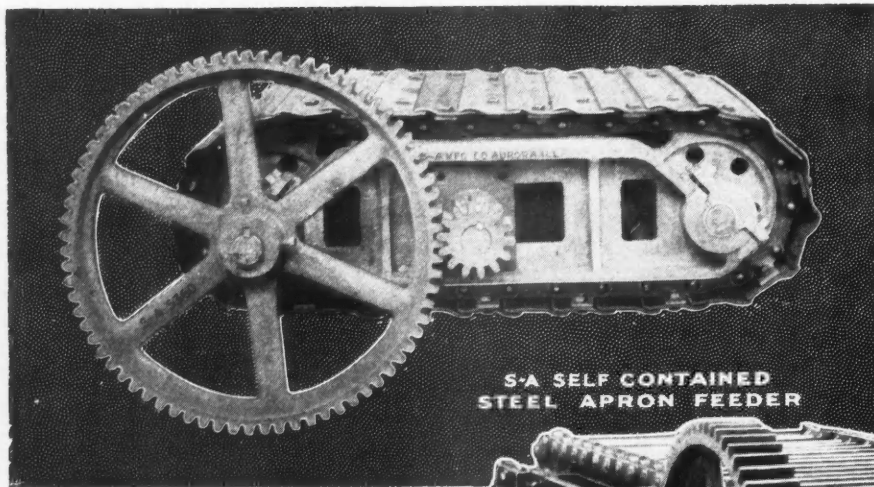
East Helena Smelter of
American Smelting and Refining Co., Montana



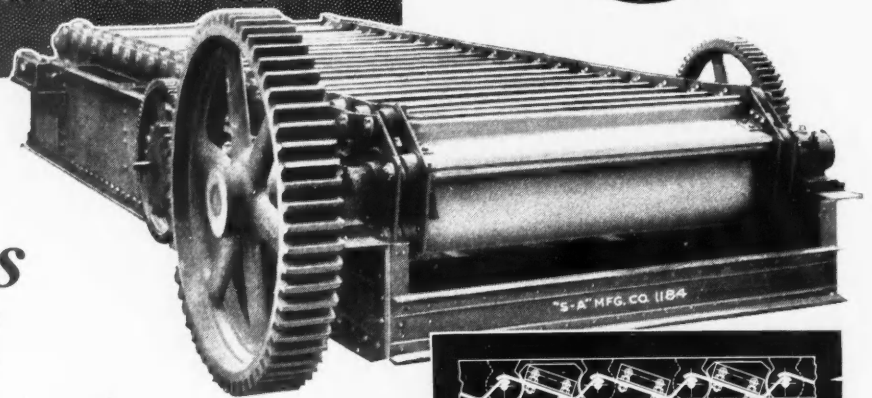
Mining Stocks—Week Ended May 16, 1925

Table of mining stocks including sections for COPPER, NICKEL-COPPER, LEAD, ZINC, GOLD, and GOLD AND SILVER. Columns include Stock, Exch., High, Low, Last, and Last Div. with various dates and prices.

Table of mining stocks including sections for SILVER, SILVER-LEAD, IRON, VANADIUM, ASBESTOS, SULPHUR, DIAMONDS, PLATINUM, MINING, SMELTING AND REFINING, and LONDON QUOTATIONS. Columns include Stock, Exch., High, Low, Last, and Last Div. with various dates and prices.



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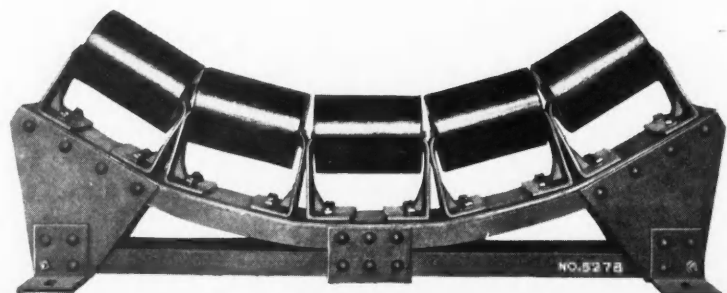
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Made in sizes for belts 24 to 54 inches wide.



ENGINEERING AND MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 119

New York, May 30, 1925

Number 22

Viewing With Alarm vs. Pointing With Pride

STATEMENTS continue to appear in the press indicating that the copper industry is in the last stages of depression; one would gather that practically all American producers will soon be bankrupt, with present prices and rate of production; that the market is being flooded with supplies that it cannot absorb, and that all the low-cost copper comes from South American and African mines. In South America, one journal of misinformation states, the copper is shipped on the backs of llamas to market, and the peon labor employed gets only a few cents a day, conditions altogether being such with which we, in the United States, obviously should not be expected to compete. Even the usually well-informed *Boston News Bureau* recently went a little wild in an editorial entitled "Economic Suicide." "Such mining companies as are paying dividends can almost be counted on the fingers of one hand," says the editor; as a matter of fact, eighteen American copper mining companies are paying dividends, fifteen of which mine their ore in the United States, and four of which—Calumet & Hecla, Copper Range, Mohawk, and St. Mary's Mineral Land—are Michigan companies, a state in which one would suppose, from all that has been said, that copper miners had all been forced into bankruptcy for lo, these many years.

Also we read in the article just cited, "Practically all of the largest producers of copper are straining every nerve to push on to the market, at home and abroad, every pound that can be gouged from the bowels of the earth, and selling it at any old price that can be secured." More calmly stated, the facts are that some companies have gradually raised production near to plant capacity in order to help meet a record world demand for copper and to cut overhead costs; many others are operating down to about three-quarters capacity, feeling that the slightly lower price that would result from a greater supply of copper would offset the slight reduction in cost of production, if the plant were run to capacity. "Gouging the bowels of the earth" and "straining every nerve" are statements catering to a public that loves sensations and has learned to speak of physiology in plain terms.

Overproduction is another common cause of complaint, and one would infer the stocks of refined copper are piling up so fast that they must be sacrificed for what they will bring. As a matter of fact, the latest available data, giving the figures for Jan. 1, show stocks to be less than they were a year before:

Stocks of Refined Copper
North and South America,
Tons

Jan. 1, 1924	155,885
April 1	119,462
July 1	112,195
Oct. 1	136,756
Jan. 1, 1925	136,454

These stocks are about equal to two months' United

States consumption, and most of this copper is already sold for forward delivery. The total does not seem unduly large, nor does it show any menacing upward tendency.

Another fallacious argument, to our way of thinking, is that the copper resources of the world are being gutted, so what will our successors do for this valuable metal? It seems to us that copper is serving the world better by being put into use as fast as possible instead of lying in the ground. The metal is not destroyed, except in insignificant proportion. It is being used but not used up, a distinction well worth observing; as a metal in discarded trolley wires it is more accessible than as a sulphide on the 2,000 level of some Arizona mine.

Copper producers are not so prosperous as the producers in some other lines of industry, and the price of copper might well be a cent or two higher without doing any great harm to the consumer, but too many crocodile tears are being shed. The copper industry is decidedly active; it is making new records in large size and low cost of production; it is showing none of the depression commonly associated with the hypochondriac about to commit suicide. We should "point with pride" instead of "view with alarm."

The Earth's Crust

THE PHRASE "the earth's crust" comes to have a more vivid significance when we read the press dispatches from Fiumicino, Italy, about 25 miles from Rome, telling of liquid lava tapped at that place by a hole only 125 ft. deep. The hole was being dug in preparing foundations for a glass factory. Gases began coming into the hole, and the laborers made their escape; then lava rose and filled it, and is now overflowing it.

Truly, the crust at this point is a thin one: and there is an astonishingly sharp line shown between this cool solid crust and the liquid lava below. A current geological conception is that rock magma in depth is approached through a long transition, during which the solid rock becomes more and more plastic; but this conception is not sufficiently supported by other than theories.

Whether the crust is everywhere underlain by fluid magma is uncertain. In any event, it is certain that the thickness varies enormously. In the western United States, as, for example, in Nevada, observations on heat increment indicate that the volcanic layer may be not so very many thousands of feet down; while in areas like the Pre-Cambrian of Canada we have no evidences of any underlying magmas since the Pre-Cambrian—practically an eternity, measured in human lives. On the Atlantic seaboard of North America, the last lava eruptions were long ago in the Triassic, yet at the close of the Cretaceous a great curved rift in the crust, reaching from western New York at least into Missouri and Arkansas, permitted the upwelling of

dikes which showed a uniform magma body underlying the whole great area.

Nearly everywhere, of course, the depth of fluid magma is so great as to be practically beyond the power of man to reach. Even in regions of volcanic activity, an occurrence like that reported is unprecedented.

Mexico Calumniated

MINING in Oaxaca, Mexico, is unmolested and regarded kindly by state and population, an engineer of our acquaintance writes. Conditions are extremely peaceful, and in every possible manner the authorities, he says, are striving to assist the companies. Labor is abundant, cheap, and docile. Ores, concentrates, and payrolls are transported without protection. In the Natividad country, he continues, is this especially true; there perfect quiet reigns and work continues peacefully. The operators are let alone, having the moral aid of the local officials, and, when necessary, other aid.

Despite this, our correspondent says, misleading information is being circulated regarding conditions in the state, especially around Natividad. From a letter that had recently come into his possession, written by a "prominent" mining man to a gentleman in the United States who had presented a partly developed mine for the former's consideration, he quotes as follows:

"... in conjunction with advice I have just received from parties operating south of the City of Mexico I regret to state that I do not feel the situation warrants my becoming interested. According to advice received from associates of mine the operating conditions down in Oaxaca, especially around the Natividad district, are not very alluring. The larger mines with a large crew and police protection can get along without much trouble, but for a small mine . . . the hindrances due to bandits and all that goes with them are for the present a little too much."

Commenting on this, our engineer acquaintance says:

"There is not a mine in the Oaxaca district or any of the adjacent districts that has even a semblance of police or military protection, either state, federal or private."

In the last thirty months, including the period of the De la Huerta rebellion, he says, there has been no instance of interference with mining operations or property by bandits. With one unimportant exception, there has been no case of payroll robbery in the last twenty-five years, although some of the payrolls are carried on two-day journeys by Indian mozos.

One can only speculate as to the source of the damaging misinformation quoted, whether it had its origin in malice, ignorance, or some selfish interest. In any case it is unfortunate that such reports should get around. The hazards of mining are enough without the addition of such an unjust burden.

The Ore Magma Theory at Porcupine

THE GEOLOGICAL SURVEY of Ontario has consistently recognized not only the close genetic connection of the ores with the granitic intrusives of Algoman age, but has recognized that the ores are pegmatitic in character. The recent published report on the Porcupine gold area by Mr. A. G. Burrows, now Provincial Geologist, confirms and emphasizes earlier opinions, summing up the situation as follows:

"The gold deposits are composite in their structure. They consist of quartz and mineralized schist in varying proportions, being either linear or in irregular masses in which the length may not be much greater than the width.

Where linear, the deposits can be called lodes and not simply veins. Where a number of more or less parallel lodes occur in a width of several hundred feet, the structure is a lode system. Lodes are often branching over part of their distance and may be called a lode series. The word 'vein' is in general use at the mines to describe an ore deposit. The deposits are not the filling of open fissures such as are often connected with veins formed near the surface. They do not show the crustification or banded character of the filling of open fissures by slow movement of mineralizing solutions. Occurring in schistose rocks which have been further sheared, many irregular lines of weakness were developed, allowing for varied entrances of the quartz into the schist. The quartz has been injected under heavy pressure and is pegmatitic in character, much like the intrusion of a rock magma. J. E. Spurr, from a study of the structure of the quartz, has referred to the injections as veindikes.¹ Along these lines, L. C. Graton in a description of the southern Appalachian gold deposits, states 'it is even possible that the vein-forming solutions representing the final product of emanations from a granite magma were injected under heavy pressure into the surrounding rocks along lines of weakness, and so, like pegmatite dikes, made spaces for themselves, by opening their own fissures.'

This conclusion that "The quartz has been injected under heavy pressure, and is pegmatitic in character, much like the intrusion of a rock magma," conforms with the Ore Magma Theory of J. E. Spurr, announced in 1923, and for certain gold-quartz veins in 1905. In distinction from previous theories that mineral veins were deposited from "waters," which passed in great quantities along openings, gradually building up ore deposits by precipitation of small quantities of metals in solution, this Ore Magma Theory argued that the ore solutions were highly concentrated—often, indeed, jelly-like or viscous; and that they advanced suddenly at a gush or in successive spasmodic gushes, along fissures and other rock openings and then crystallized either as dike-like bodies (veindikes) or by replacement of wall rocks, or both. These ore solutions were defined as a phase of the solution, or magma, from which pegmatites are crystallized, and were therefore called ore magmas, a term necessary for their distinction from waters. Pegmatite magmas, it is generally acknowledged, are a differentiation phase from ordinary rock magmas.

Development of the Ore Magma Theory

THE ORIGIN of gold-quartz veins as a variation of pegmatites has been argued as far back as 1861 by Thomas Belt, the distinguished English mining engineer and naturalist, but the idea was ignored by geologists. These views were independently advanced by J. E. Spurr in 1898 as an explanation for the Yukon gold-quartz veins. This conception, however, was of highly heated water as the end product of granitic differentiation, this magmatic water being the ore solution. But in 1905, studying similar gold-quartz veins in Nevada, Spurr pictured the ore solution in this case as concentrated and the gold-quartz as intrusive, just as pegmatites are intrusive. In 1907 the Zonal Theory of Spurr showed the interrelation of the different metals. This theory postulated that in the final pegmatitic residue of a magma many metals are present, and that with decreasing temperature each is separately precipitated, the deep-seated gold-quartz ores representing one of the deepest zones, close to the pegmatites. This theory, now generally accepted, pictured at first the ore solutions essentially as magmatic

¹"The Gold Ores of Porcupine," *Mining Journal-Press*, Oct. 13, 1923.

waters, except in the case of certain gold-quartz veins and ore-bearing pegmatites. The Ore Magma Theory, proposed in 1923, substituted, as above stated: for magmatic waters, highly concentrated and dense magmatic residues; for long circulation, a definite stage of injection; for fissures already open, the forcing open of fissures in many cases by the ore magma; for slow accretion of precipitation, simple crystallization from the injected ore magma.

A Government Monopoly in Diamonds

DISCUSSING THE FUTURE SUPPLY of diamonds in an earlier editorial (July 26, 1924), we said that it behooved the diamond miner to remember that the monopoly of his product might be short-lived and to strive to regulate the supply to the demand so long as a fair price was obtainable. The great interests that have long controlled the bulk of the world's diamond supply have this well in mind, and have succeeded in keeping prices at a point where the diamond cannot but be a precious stone. New resources as yet undiscovered or undeveloped may sooner or later give cause for worry, but such dark clouds have not yet appeared above the world's horizon.

Nevertheless, whatever be the reason, the Government of the Union of South Africa is seeking to establish complete control over the diamond industry within the Union, according to advices from the Department of Commerce here. A bill has been introduced, which, if enacted into law, will give the government a monopoly in disposing and selling rough and uncut diamonds, alluvial stones excepted.

Under its terms the Governor General may determine in June and December of each year the maximum quantity in value of diamonds to be disposed of in the Union during the succeeding six months by any and all producers. He may also prescribe from time to time the per cent of this total that any one producer may dispose of, effective from the following Jan. 1. At any time he may, by written notice, set the minimum price at which a producer may sell any particular class of stones during the period of the notice.

The measure empowers the Governor General to appoint a board of three members—the Union Diamond Board—the members to be selected for their knowledge of the diamond business and to give their whole time to the work. During the period of their service they may not be connected with any business for mining or dealing in diamonds. The function of the proposed board will be to deal in and hold stocks of diamonds and to export the stones; also to advise the Governor General as to maximum quantities to be produced and minimum prices to be set. It may demand diamonds from any producers for export and sale on their behalf, the costs to be charged to them. Funds, to be repaid if possible, will be provided by the government for the board to carry on the work. Producers may be directed, by proclamation, to sell their diamonds only to the Board, and the latter may be given the sole right to export them, but may delegate this privilege to others.

The bill, as drawn, would permit the Governor General by proclamation to invalidate any private agreement made by producers that is in effect Dec. 31, 1925. Various penalties are provided for its infringement.

Those who oppose the measure say that it is loosely drawn; that the government cannot control an industry with such international connections; and that the

attempt will produce a reaction against the Union in the investment field.

The slogan of "less government in business," which was popular a short time ago and which has lost little of its force, might well be seriously considered by those members of the Union Government who are sponsors for the measure. Meddling of this sort with private industry had better be avoided. It seems especially needless when the commodity meddled with is a luxury.

The Mining Industries' Share of Taxes

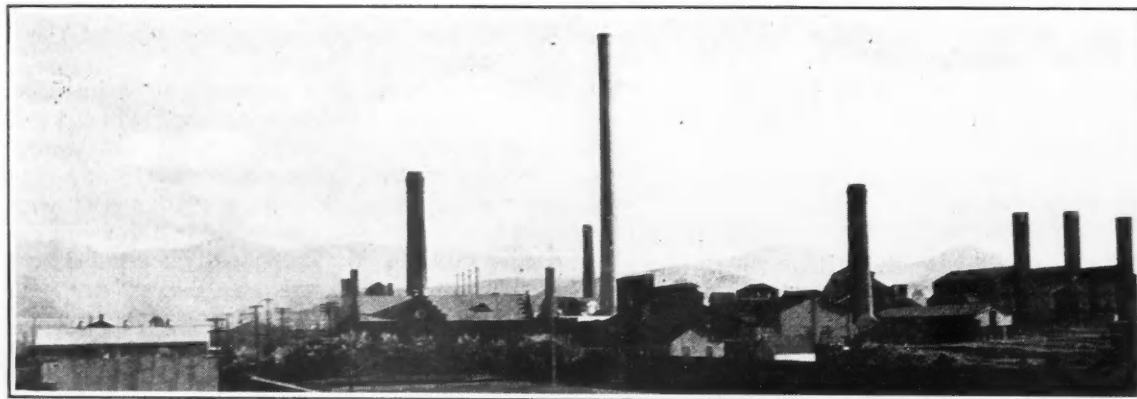
ACCORDING to an article in *The Nation's Business* for May, quoting the Department of Agriculture, the mining and quarrying industries in 1922 paid out 62 per cent of their net profits for taxes, of which state and local taxes were 45 per cent and federal taxes 17 per cent. This was the highest of all the major industries except agriculture, whose total was 65 per cent. The nearest that any other industry came to the two above was "Hotels, Theaters, and Other Service Organizations," which paid a total tax of 40 per cent of their net profits. Transportation and public utilities paid a total of 37 per cent; construction, 35 per cent; finance, banking, and insurance, 32 per cent; wholesale and retail trade, 28 per cent; and manufacturing, 25 per cent, of which 14 was for state and local taxes and 11 was for federal taxes.

Treasury Department statistics enabled a compilation of figures giving comparison along different lines. For example, out of each \$100 of receipts, mining and quarrying paid \$3.12 in taxes, of which \$2.27 was for state and local taxes and 85c. was for federal taxes. Again, agricultural corporations were more heavily taxed, with a total of \$3.94, of which \$3 was for state and local taxes and 94c. was for federal taxes. The least is wholesale and retail trade with a total of 86c.; but, according to this method of comparison, transportation and public utilities paid out the largest percentage of receipts, or \$5.74 on each \$100.

Another comparison which is made in the article from which we are citing is the percentage of net profits to the "fair value" of capital stock of corporations, as the fair value was established by the Treasury Department for the capital stock tax, as follows:

	Per Cent
Agriculture, etc.	.3
Mining and quarrying	.9
Transportation and public utilities	7.8
Construction	4.4
Finance, banking, and insurance	5.7
Wholesale and retail trade	7.2
Manufacturing as a whole	9.0

Readers of the *Mining Journal-Press* may draw such conclusions as they like from the comparisons above set forth. One conclusion may be that if agriculture has been in a condition deserving of sympathy and assistance during the last few years, mining has been in the same boat; but while the government has made great efforts to help the farmer, it has not paid any attention whatever to the problems of the miner. We may even go further and say that while the government looks upon the farmer with approval and concern, the habitual attitude of Congress and the executive branches of the government toward the mining industries is one of suspicion. It is difficult to find a reason for this, unless it be that mining has so few friends at court.



East Helena plant of the A. S. & R. Co. in Montana

One of the oldest smelters in the country. Coeur d'Alene lead concentrates and Great Falls zinc residues are smelted here.

Notes on Western Lead Smelters

*Constant Improvement in Current Practice—Mechanicalization—Roasting—
Smoke Treatment—Byproducts*

By Arthur B. Parsons

Assistant Editor

A CHARACTERISTIC of metallurgical plants is eternal remodeling. New equipment is always being installed. Lead smelting is, perhaps, the most nearly standardized of metallurgical operations; and yet on a tour last summer, during which I visited nearly all the lead-smelting plants in the Rocky Mountain region, I found at each some interesting addition or alteration, either under way or recently completed.

Without going into details I shall attempt to set out the "why" and "how" of some of the changes. The principal reasons may be enumerated as follows: (1) Need for more economical operation. In Utah and Idaho competition for ores is strong; in Colorado the mining industry, if it is to survive, must be nursed by making smelting charges as low as possible. (2) Increased zinc content of ores and the increased proportion of slimed flotation concentrate received by the smelters. This has affected metallurgy, in a sense; but even here the question of equipment and mechanical manipulation are more important. (3) Need for recovering the maximum proportion of the marketable metals. The good market for arsenic has been a factor in this connection; and losing lead is a more serious matter when the price is 10c. than when it is 5c. Bearing these causes in mind it is easy to classify the changes or developments:

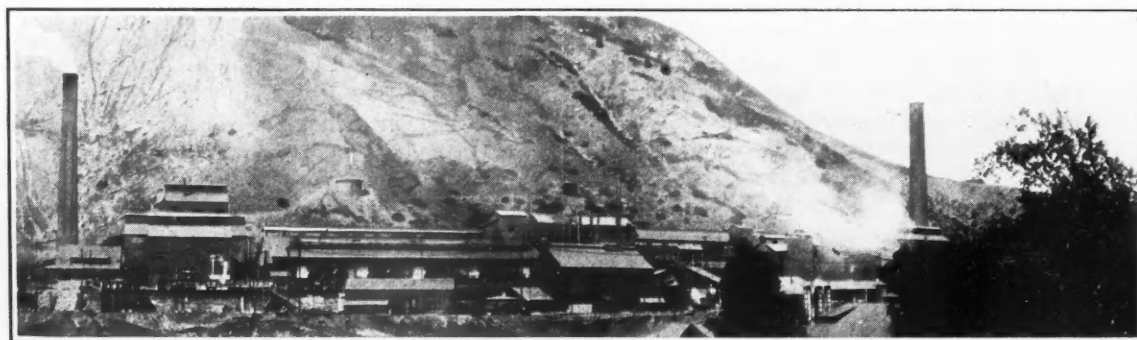
1. The increased use, particularly at the older plants,

of mechanical devices for handling materials in process, the object, of course, being to eliminate workers. The importance of this has been increased greatly by the advance in wage scales in recent years. A great deal of equipment has been installed with the object of paring costs to the minimum.

2. Improved roasting. With increased zinc in the blast-furnace charge, the elimination of sulphur in the finished roast to below 4 per cent is essential. Double sintering on Dwight-Lloyds is resorted to frequently; or thorough roasting in combinations of multi-hearth furnaces and sintering equipment is provided. This means more plant per ton handled.

The propensity of zinc sulphide, largely infusible in the furnace charge, to obstruct furnace operations is well known. It forms a "mush" in the crucible and contaminates both slag and matte. It also stimulates the formation of accretions on the walls, and "sows" in the crucible; and naturally accumulates in settlers or fore-hearths, causing them to freeze up quickly. These troubles are best alleviated by adequate roasting.

In this connection should be mentioned the devices used for accurate proportioning and thorough and uniform mixing of the sinter-machine charge. This is essential to a good roast, and one function of new conveyor-belt systems is to afford mixing.



A. S. & R. plant at Durango, Colo.

From left to right: the sulphating plant, Godfrey roasters, sintering machines, blast furnaces.

3. More thorough "clearance" of the flue smoke. Lead, silver, arsenic, cadmium, and bismuth are among the marketable products that are recovered as dust and fume in the flues. Baghouses and Cottrell treaters are more than a means of forestalling (so far as possible) the "smoke-farmer." The most interesting developments are in connection with the improvement of Cottrell apparatus.

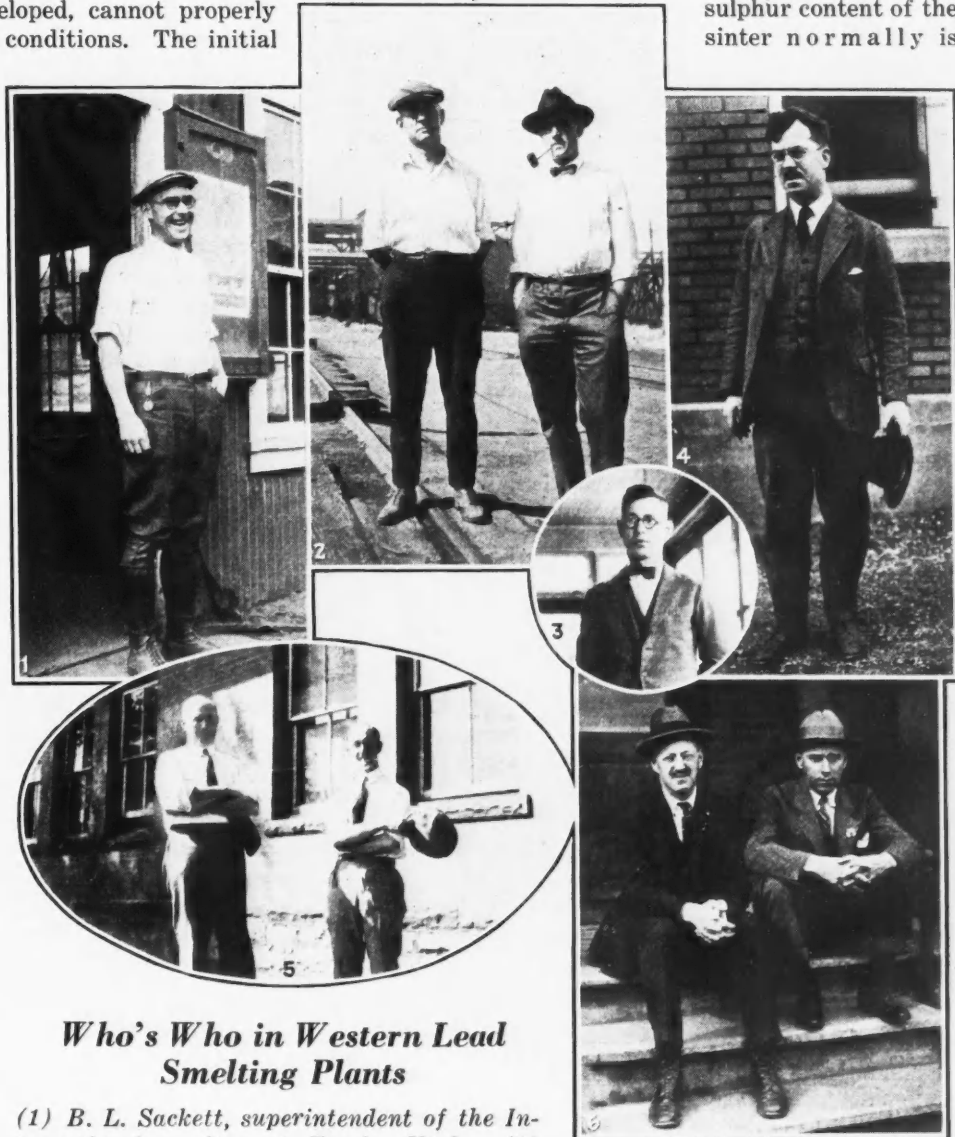
At the same time there is a growing realization that the Cottrell, as at present developed, cannot properly displace the baghouse under all conditions. The initial cost of the baghouse is greater, but it is more dependable in its results. The Cottrell is sensitive to slight changes, and accordingly the "clearance" is likely at any time to fall below the high point attainable under ideal conditions, thereby lowering the average efficiency. The baghouse is almost "fool-proof," and except for an occasional burnt bag, which can be quickly provided for, nothing interferes with efficient clearance. When roaster and other acid gases are present the baghouse may be impracticable, but it serves very well for blast-furnace smoke, and it has its advocates because of the operating advantages that have been mentioned.

4. Special plants for the recovery of these "byproducts," particularly arsenic, have been installed at several of the smelters and will be mentioned.

In regard to the Kodak pictures of the plant operators that are reproduced here it may be explained that some of the men who are obviously "dressed up" more than others were caught on Saturday afternoons and Sundays, and that they do not wear such decorative raiment on week days. To each of them I want to extend my thanks for the cordial way in which they showed me around the plant and answered questions.

At the Arkansas Valley plant of the A. S. & R. Co., at Leadville, Colo., changes entailing the installation of new equipment in the system for supplying the four Dwight-Lloyd machines and for handling the blast-furnace charges have materially reduced costs. Primary roasting is done in one Wedge and twelve Godfrey furnaces, the product forming 70 per cent of the Dwight-Lloyd charge. A newly-built plant provides for the proportioning and mixing of the sinter-machine charge by means of a set of apron feeders drawing from hopper-bottomed bins. Blast-furnace slag, miscellaneous ores, and returned Dwight-Lloyd screenings make up the

remaining 30 per cent. Further mixing and moistening of the charge is accomplished on Murray tables. These are essentially horizontal revolving disks about 7 ft. in diameter, fitted with adjustable plows to push a stream of ore into the spreading chute that feeds the Dwight-Lloyds. These are fired with slack coal. Since putting the mixing plant into operation the percentage of fines returned for resintering has been reduced from 40 to about 12 per cent. The sulphur content of the sinter normally is



Who's Who in Western Lead Smelting Plants

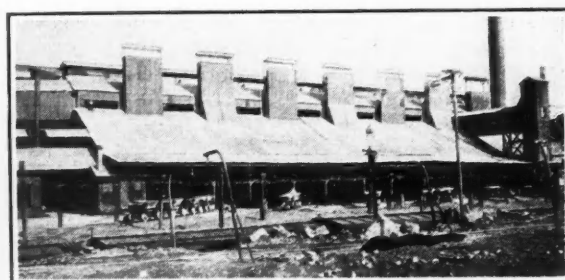
(1) B. L. Sackett, superintendent of the International smelter at Tooele, Utah; (2) Douglas W. Jessup, assistant superintendent, and Robert Wallace, superintendent of the United States smelter at Midvale, Utah; (3) Alfred F. Beasley, assistant superintendent, and (4) M. H. Sullivan, superintendent of the Bunker Hill smelter at Kellogg, Idaho; (5) John F. Austin, general superintendent, Colorado Department of the American Smelting & Refining Co., and R. P. Reynolds, superintendent of the A. S. & R. smelter at Durango, Colo.; and (6) A. A. Zimmerman, superintendent and W. J. O'Connor, manager of the A. S. & R. smelter at Helena, Montana

around 4 per cent. An ingenious device revolving near the feed end of the sinter machine marks the bed into 1-ft. squares by indenting the top to a depth of about one inch after the fashion of makers of caramel candy. This makes lines of weakness and results in the formation of fewer fines when the cakes are broken.

The cars are loaded by gravity from the sinter bin, run by motor to the scales, elevated to the charge floor by an automatic chain haul, and there transferred by an electric-battery lift-truck to the furnace. This last-



Midvale plant of the United States S. R. & M. Co. in Utah
Electric locomotive hauling slag cars to dump



Tapping floor showing the seven blast furnaces

named machine is made by the Automatic Transportation Co. The coke is spread carefully on top of a 12,000-lb. charge.

Former practice was to tap the blast furnace into a pot and transfer to a large separator for the parting of the slag and matte. The slag now averages $7\frac{1}{2}$ per cent metallic zinc, and this procedure is impracticable. Instead, two settlers are used. The charge contains an unusual amount of magnesia and alumina, and these, in conjunction with the zinc, give considerable trouble in furnace operation. Besides tending to make the slag thick and streaky and sticky, magnesia raises the temperature of formation. The slag chills quickly. Zinc in the charge, even if well roasted, seems to aggravate this difficulty. An interesting feature is the use of some anthracite slack as a substitute for part of the coke as blast-furnace fuel.

The typical furnace charge consists of:

Material	Pounds	Pounds
D. & L. sinter.....	1,350	
Limestone.....	150	
Silica.....	100	
- Total.....	1,600 × 6 cars	9,600
Aspen lime ore—1 buggy.....		600
Direct bed ores—2 buggy.....		1,200
Slag—1 buggy.....		600
		12,000
Coke.....		1,200

At intervals of several months all the furnaces in blast are run on a high matte charge for a few days. This is preferable to running one furnace for a longer period, because it makes it necessary to prepare but one sinter and one blast-furnace charge at a time.

Arsenic and cadmium are recovered in the baghouse that handles the blast-furnace smoke. Cadmium, incidentally, tends to make a hot top on the furnaces and threatens to burn the bags. Careful attention is paid to keep the temperature below 250 deg. F. At intervals a section of the baghouse is "cut out" and the collected dust is ignited. The calcine is returned to the blast furnace until a product assaying at least 19 per cent cadmium or 35 per cent arsenic (as As_2O_3) is made. This is shipped to the Globe plant at Denver for refining. A modified type of Cottrell treater has been developed for the roaster gases.

E. P. Chapman, who is superintendent of the plant, was away at the time of my visit, and J. G. Newton, assistant superintendent, showed me around the works. Mr. Newton has since been transferred to Durango.

HIGH ZINC CONTENT AT DURANGO SMELTER

The principal source of ore supply for the Durango smelter of the A. S. & R. Co. is the San Juan region in southern Colorado. In accord with the tendency already mentioned, the proportion of fine-ground flota-

tion concentrate and the average zinc content of the material smelted have increased greatly in recent years. Blast-furnace slags assay from 13 to 15 per cent zinc. Ten Godfrey furnaces, fired with coal from the company's own mine, serve as primary roasters; but even so, recent work has shown a big advantage in double-roasting part of the material on Dwight-Lloyd machines. The primary charge is composed of zinky concentrate, lead residue from the new "Sulphating" plant, (in which most of the zinc from a lead-zinc middling has been leached as sulphate), and 10 per cent crushed lime. This is sintered to 7 or 8 per cent sulphur, crushed to pass $\frac{1}{2}$ in., and used as a constituent of the charge going to the secondary Dwight-Lloyd machines. As much as 25 per cent of this secondary charge is crushed sinter and experiments are being made with larger proportions. A sinter containing only 4 per cent sulphur is made, and the physical condition is much better than when no primary sinter is used. The net capacity of the equipment in finished sinter is increased materially by the "stage" treatment. The machines are fired with oil, and are run much more slowly for a 4-in. bed than was necessary before the zinc content of the concentrate became so high.

Proportioning and mixing of the Dwight-Lloyd feed has been improved by installing belt conveyors with automatic feeders. The unroasted material is conveyed to a Murray table which feeds two other conveyors onto which the Godfrey roasters discharge. Each sintering machine likewise is equipped with a Murray table.

CAST-IRON JACKETS ON BLAST FURNACES

The three blast furnaces have cast-iron instead of steel-plate jackets; the first-named are found more satisfactory, because of the fact that the available cooling water is likely to be dirty. This might cause blistering of plate jackets. Recently, one of the furnaces was replaced by a larger one, 44 by 224 in. at the tuyères. The fuel is coke made at the company's own ovens, with 2 per cent anthracite slack substituted for some of the coke at times. Two comparatively small settlers are used for each furnace. The slag averages around $1\frac{1}{2}$ per cent lead. Considerable remodeling is in progress, with the object of facilitating the handling of charges to the blast furnaces. The plant is an old one, however, and at best the arrangement will leave something to be desired. Normally, the charge carries 4 per cent copper. A 20 per cent matte is made, and this is crushed, roasted, and concentrated at intervals in one furnace to 35 per cent for shipment. A single Cottrell treater of the pipe type handles the smoke from both the roasters and the blast furnaces, and no bag-house is provided.

The "Sulphating" plant is an adjunct to the smelter that has recently been completed at a cost of \$600,000. The treatment of complex lead-zinc middlings in this plant was described in an article appearing in *Mining Journal-Press* of Jan. 10, 1925.

R. P. Raynolds is superintendent. J. F. Austin, who gives Mr. Raynolds moral support in the accompanying picture, is general superintendent for the Colorado department of the A. S. & R. Co. He makes his headquarters at Denver.

Compared with the two smelters in Colorado, the Midvale, Utah, plant of the United States Smelting, Refining & Mining Co. is new and the handling of materials is more economically accomplished. The blast furnace charges are drawn into a scale car from overhead bins through arc gates. The car has ten beams, allowing as many ingredients to be added to the charge. Additional material can be added by hand or by belts. Both car and gates are operated by electric motors, as are the four-ton charge cars. There are some interesting details of operation; and the cadmium and arsenic plants are comparatively new.

Four Wedge furnaces are in operation and a fifth is being installed. They roast ninety tons each per day of table and flotation concentrate or raw ore, giving a calcine reduced from 32 to about 16 per cent sulphur. Six Dwight-Lloyd machines, using the Trail or Stewart grate—which seems to be in use almost everywhere—make a sinter containing 3½ per cent sulphur. Pulverized coal or oil is the fuel. Over the entire length of the machine is a hood to remove the gases, and thus to promote the health and comfort of the men. Conveyor belts are used to mix Wedge calcine, raw sulphide and oxidized ores for the sinter-machine feed. As usual, thorough mixing is emphasized. Fines returned to the Dwight-Lloyd machines average 15 per cent. During the crop-growing season six tons of coal is burned daily at the bottom of the roaster stack to heat the gas and give it sufficient velocity to assure adequate dissipation.

Successful work was done at Midvale some years ago in feeding pulverized coal through the blast-furnace tuyères, but this has been discontinued for various reasons, other than failure to effect economy. The lead is allowed to overflow continuously from the well, so as to maintain a constant level and retard the formation of crucible crusts.

SULPHUR USED TO DROSS COPPER

An interesting point is the stirring of sulphur into the lead to dross the copper. For this purpose is used a home-made device consisting of a rear end of a Ford motor transmission with the differential "frozen." It is driven at 250 r.p.m. by means of a chain and sprocket and a small electric motor. A short blade is attached to effect the agitation. This is a cheap and efficient device. The use of sulphur has been tried and abandoned in some plants; the secret of success, it seems, lies in close control of the temperature.

Five of the seven blast furnaces were in operation last summer. The slag averages 9 per cent zinc oxide, and extra iron is required on the charge. Scrap iron and turnings are used in the proportion of 200 lb. to a four-ton charge, as being more economical than buying the equivalent in iron ore, though some available iron ore is used. Blast-furnace gases are kept below 300 deg. F., which is the danger point for the burning of the bags in the baghouse. Bristol recording thermom-

eters are used in the downtake of each of the blast furnaces and incidentally on the arsenic furnaces. Bristol pressure gages are in use on the Dwight-Lloyd machines.

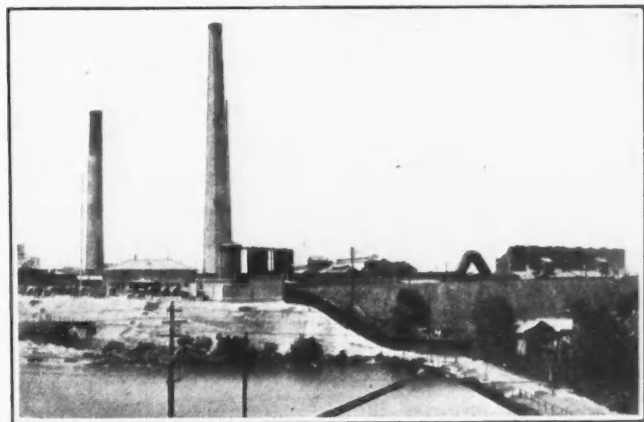
The arsenic plant consists of two units, one for treating the blast-furnace flue dust and the other for handling arsenical ores, speiss, and similar material. The first unit consists of three Brunton furnaces, which volatilize the arsenic from the dust. This crude arsenic is recovered in a series of twelve brick kitchens, from which it is removed and refined in one of two reverberatory furnaces. The volatilized product is condensed in another series of kitchens, producing a finished product containing 99 per cent or more arsenious oxide (As_2O_3). The second unit is entirely separate from the first. It consists of a McDougal furnace for roasting the ores, four hopper-bottomed flues, to hold the condensed arsenic, and a baghouse.

After the removal of the arsenic in the Brunton furnaces the cadmium-bearing residue is roasted with sulphuric acid. The resulting sinter is ground in a ball mill and agitated in a Pachuca tank with water. The residue is filtered out and the cadmium is precipitated electrolytically on aluminum cathodes. The anodes are of Duriron. The liquor is returned to the Pachuca circuit and the cadmium melted and cast as metal.

Fuller-Lehigh mills are used to pulverize coal for use in the assay office, cadmium furnaces, arsenic furnaces, and the Dwight-Lloyd machines. Robert Wallace is superintendent of the plant and Douglas W. Jessup is his assistant.

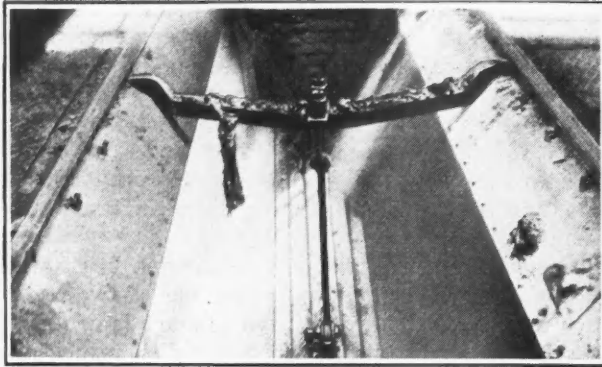
NEW HANDLING METHODS AT MURRAY SMELTER

The smelter at Murray, Utah, is the largest and in many respects the "star" plant of the A. S. & R. Co. Handling methods, though not as efficient as at the plants more recently built, are fairly convenient. Bedding of the blast-furnace charge is to be replaced to a considerable extent, and for this purpose steel arc gates are being placed under the main tiers of ore bins to facilitate direct drawing of the individual ores into small cars or buggies. These buggies are provided with hard rubber tires, made by the Goodyear company, as are also the Fordson tractors that pull trains of buggies about on the charge floor. A novel use of the Ford tractor is its adaptation to operate as a shovel to load charge buggies in the bedding bins. This is called a Lesman loader. It has a ¼-cu.yd. bucket lifting about 300 lb. The loader has proved extremely economical in

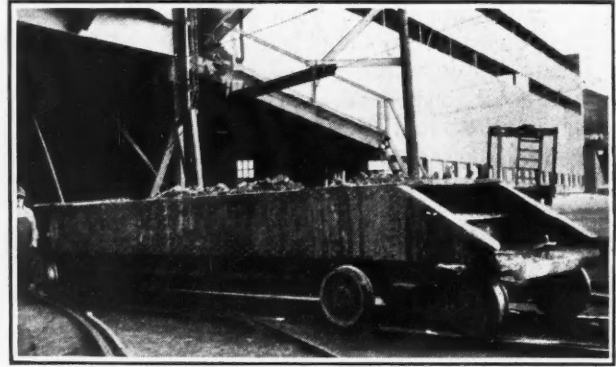


A. S. & R. plant at Murray, Utah

The blast furnaces are at the extreme right. In the foreground is a large pond for cooling water.



Suspended spreader for blast-furnace charges



Electrically driven blast-furnace charge car

International smelter at Tooele, Utah

view of the increased wage scale for hand shovelers. A two-man scraper, operated by drag lines and a small electrically driven hoist, is used in spreading the materials that compose the beds. The charge floor is paved with cast-iron plates, and weighing and filling of charge cars of 9,000-lb. capacity is accomplished with remarkable dispatch with the equipment mentioned. A typical charge is:

Material	Pounds
Bed (including ore, slag and barrings).....	1,000
Sinter.....	5,500
Limestone.....	1,200
Iron ore.....	1,000
Briquetted flue dust, etc.....	300
Total.....	9,000
Coke.....	1,100
Dross.....	400

Of six lead blast furnaces in operation when I visited the plant, four were on a regular lead charge, one was on a "copper" charge with a high matte fall, and one on a "bismuth" charge, treating briquetted bismuth fume from the Garfield and Tacoma copper smelters. A feature is the excellent hoods on all of the furnaces and an ingenious shield for the tapper whose duty it is to shut off the flow of matte from the settler. A large square lined settler, followed by a smaller unlined oval settler, is used.

Wedge roasters are fed with a mixture of 30 per cent crushed crude ore, 30 per cent table concentrate, and 40 per cent flotation concentrate. The roast contains from 12 to 14 per cent sulphur. Oil or coal is used alternatively as fuel.

A typical ore charge to the Dwight-Lloyd machines is as follows:

Material	Per Cent
Wedge roast.....	35
Miscellaneous siliceous ores (diluent).....	25
Dwight-Lloyd fines.....	12½
Garfield granulated converter slag.....	7½
Raw sulphides.....	20

An alternative Dwight-Lloyd charge is as follows:

Material	Per Cent
Matte (preroasted in Wedge).....	75
Siliceous diluent.....	25

An effective mix is obtained by drawing from any required number of sixteen steel bins onto a conveyor belt which feeds a cross belt that discharges onto an inclined conveyor. Murray tables feed the various sintering machines, the necessary moistening water being sprayed at this point.

When blast-furnace gases are too hot, they are cooled by sprays to 280 deg. F. before entering the baghouse. The dust, containing 50 to 60 per cent arsenious oxide, is shipped to the Globe plant, at Denver. Roaster smoke is conditioned for passage through the Cottrell plant

by introducing the fumes of boiling sulphuric acid into the flue. Water vapor as a conditioner has not proved efficient in effecting a satisfactory clearance of the dust and fume. The Cottrell treater is of the pipe and wire type, the wires being at the center of pipes of 6-in. diameter.

A special plant has been treating one class of ore that contains 18 per cent arsenic. A Wedge roaster is used to volatilize the arsenic. Mechanical dust is caught in a series of flues, and a product ranging from 90 to 92 per cent As_2O_3 is recovered in a series of kitchens, through which the gas and fume pass. A baghouse catches anything that escapes the kitchens.

A. H. Richards, superintendent of the plant, was until recently in charge of the Garfield copper smelter.

The lead plant of the International smelter at Tooele, Utah, has two advantages over the other smelters described: first, it is comparatively new (in this respect it shares honors with the Bunker Hill smelter), and second, the copper plant in conjunction with it assists in making economical operation possible. The equipment for handling materials is largely mechanical and the cost is low. Primary roasting is done in McDougall furnaces. The feed for the Dwight-Lloyd sintering machines consists of McDougall calcine, crude ore, lime rock, copper and lead converter slag, and flotation concentrate. All of these constituents except the last are fed onto a belt by means of Challenge feeders; the concentrate is handled by short belt feeders. "Bedding" is accomplished on the conveyor, and mixing is effected by passing through a conical device equipped with rables that work the material toward the center. A Challenge feeder is also provided for each sintering machine. The machines are fired with gas-oil fuel, requiring an average of about 65 gal. for 125 to 130 tons of unsintered feed. The sulphur content is reduced from 11 to 12 per cent to 2½ or 3 per cent in a single step.

The blast furnaces are charged from electrically driven cars, that draw appropriate constituents, weighed on suspended scales, from beneath the various storage bins. One of these cars is shown in the accompanying photograph. The coke is put in the car first, the theory being that thorough mixing is needed and that the heavier ore will mingle with the lumps of coke when the charge is dropped into the furnaces. At some smelters the effort is made to make alternate layers of ore and coke. A typical 8,000-lb. charge is composed of: Dwight-Lloyd sinter, 5,600 lb.; limestone, 1,200 lb.; and miscellaneous ores, 1,200 lb., to which is added 500 lb. of dross and a few hundred pounds of

scrap iron. A novelty is a magnetic crane that lifts scrap iron from a railroad car directly to the charge car. A large settler, lined with silica brick set with thermolith mortar, and which has a life of from two to three months, receives the slag from the blast furnaces. It is followed by a small unlined settler.

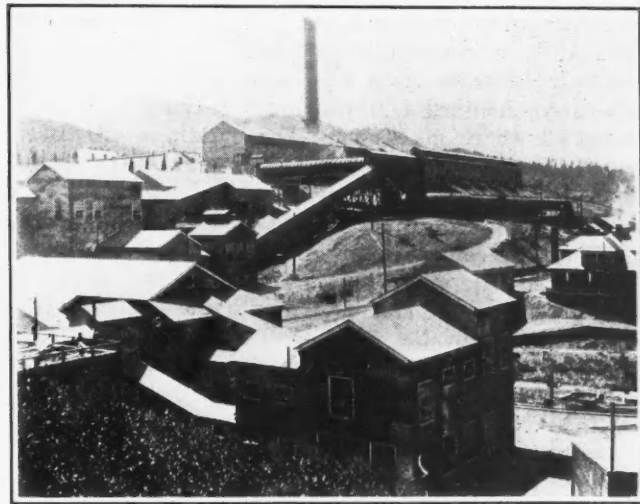
"CYCLONE COLLECTOR" FOR BLAST-FURNACE SMOKE

An unusual feature is the use of a large centrifugal "cyclone collector," 18 ft. in diameter and 16 ft. high, which receives the effluent smoke from the blast furnaces. A large proportion of the dust is collected at the outset in the conical hopper at the bottom of this cyclone.

A matte fall of 8 or 12 per cent is usual. This matte is transferred while hot to a special converter in the copper department of the plant. It contains 15 per cent copper and 14 per cent lead. The charge is blown to 2 or 3 per cent lead and 1 or 2 per cent sulphur and the basic slag is skimmed, granulated, and returned to be added to the blast-furnace charge. The remaining matte then goes to the copper converter. This is an economical way to dispose of the lead-furnace matte and illustrates an advantage of having the lead and copper plants together. The blast-furnace and lead-converter smoke all passes through baghouses, most of the dust and fume being clinkered and returned to the furnaces.

A special treatment for the recovery of arsenic has been devised and found satisfactory. The equipment consists essentially of five standard McDougall furnaces. They are arranged in two units—a roaster and a condenser with the effluent of the first condensers being combined to pass through a second condenser. The roasters are fired with coal on the sixth hearth, the temperature of the bed on that hearth being in the neighborhood of 600 deg. C. About 85 per cent of the arsenic, which is sublimated in the roaster, is recovered in the first pair of condensers as a product averaging 95 per cent As_2O_3 . A baghouse collects for re-treatment the fume that escapes the second condenser. The net recovery is 60 to 70 per cent of the contained arsenic.

Cottrell treaters are used at the smelter for the Dwight-Lloyd and McDougall smoke. The latter installation is of the flue type, the principal features having been developed at the Tooele plant. The grounded electrodes are corrugated iron plates suspended vertically in and running lengthwise of the flue. They are spaced 9 in. apart, and midway between them are rows of ¼-in. iron pipes, placed horizontally and 6 in. apart vertically. These are the discharge electrodes. This treater recovers flue dust—not fume—and is credited with



Bunker Hill smelter, at Kellogg, Idaho

The "gunited" buildings in the foreground house the new sampling plant. The blast furnaces are at the right of the photograph and do not appear.

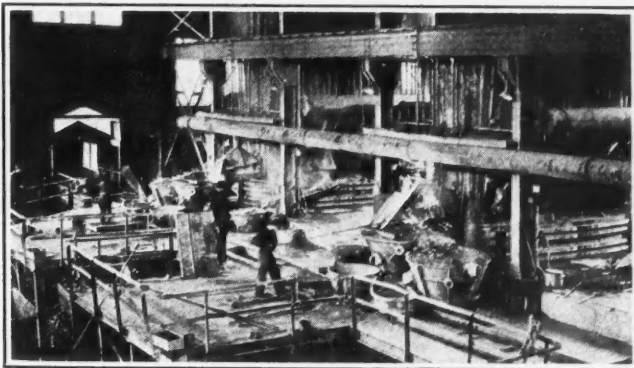
saving 96 or 97 per cent of the copper and precious metals. A feature of the flue-type treater is that advantage can be taken of the "selective" precipitation of the various constituents. The copper precipitates quickly and is collected in the first hoppers; the lead predominates in the last hoppers. So marked is this segregation that the material in the last few hoppers is returned to the lead plant for re-smelting.

Incidentally, good results have been obtained in a Cottrell unit used for the copper-converter gases. A relative humidity of about 60 per cent is desired, and this is accomplished by introducing a high-pressure (225 lb.) spray of cool water into the gas by means of a special nozzle made by the Spray Engineering Co. The gas is cooled and conditioned so as to give the maximum clearance. It has been necessary, because of the corrosive character of the spray after passing through the gas, to provide a special lining for the section of the flue where it is introduced. Vitrified brick laid with a mortar of silicon sand and a little portland cement has been found to resist the action successfully. B. L. Sackett is superintendent of the smelter, and Carlos Bardwell is his assistant.

BUNKER HILL SMELTER NEWEST IN UNITED STATES

Though the Bunker Hill smelter, at Kellogg, Idaho, is the newest and one of the best-designed lead plants in the United States, extensive alterations and additions were made in 1924. These consisted principally of a new plant for crushing and sampling, and the completion of an extensive smoke-treating plant in which additional baghouses and a large new Cottrell installation are included.

The new crushing and sampling plant comprises five separate buildings connected by housed belt conveyors, and consists of three units: (a) the sulphide plant in which an Allis-Chalmers jaw crusher, 48-in. horizontal Symons disk pulverizer, 42 by 18-in. Traylor heavy-duty rolls, and 8-ft. Hum-mer screens comprise the principal equipment to reduce sulphide ore to ¼ mesh for roasting; (b) the oxide plant, in which direct-smelting ores are crushed to 2½-in., for the original sampling (the cut is subsequently reduced in a Traylor gyratory and Traylor rolls); and (c) a "first-roast" crushing plant in which primary sinter is crushed for secondary roasting.



Tapping floor at Bunker Hill

Note the small settlers that may be replaced by means of the crane in a few minutes

A revolving-screw crusher, Mitchell vibrating screen, and Allis-Chalmers rolls are used in this plant, which is entirely separate from the other units. No elevators are used, inclined belt conveyors serving to raise the material where necessary. The buildings are covered with gunite and window and door sashes are steel, so that the fire hazard is small.

Constituents of the Dwight-Lloyd charge are either delivered by conveyor belt or by standard railway cars to a series of storage bins arranged in two rows, back to back. The ore can be fed into the desired bin by means of a movable Stephens-Adamson tripper. The different ores in turn are drawn from the bottom of these charge bins by belt conveyors that feed a long inclined belt which goes direct to the Dwight-Lloyd machines. The ores receive a further mixing in a blind trommel before they are fed to the machines.

The sulphur in the first roast is reduced to 7 per cent and the finished roast contains about 2 per cent. The charge for the finishing roasters will contain from 70 to 100 per cent of the first-roast material, depending upon the zinc and sulphur content of the ores and concentrates that are being smelted. The first roast is crushed so that 80 per cent will pass 4 mesh. Most of the iron content of the charge is supplied by an iron middling product that is made in the Bunker Hill & Sullivan concentrator. The charge bins are also arranged so that any desired proportion of the first roast can be run back with the first-roast charge. This first roast will lower the sulphur content, if the charge is too high in sulphur, or supply some dry material to absorb the moisture in the first charge. This practice also supplies some coarse material when the first charge is heavy in flotation and fine table concentrates. The fuel used is oil. Pulverized coal had been tried out previously, but was found to be less satisfactory.

The method of handling blast-furnace charges is probably the most efficient in use anywhere. Twenty-four bins, each of 3,600-cu.ft. capacity, are provided with two steel weighing hoppers, each suspended from a Fairbanks scale. The scale man keeps the determined amount of material—sinter, ore, flux, or coke—in the hopper ready for instantaneous discharge into the charge car, which is hauled by a four-ton electric locomotive to the blast-furnace charge floor. The four furnaces, 48 by 180 in., have two tiers of steel jackets. There is a cast steel top that reaches from the top jacket to the feed floor.

Zinc is a bothersome element in the operation of the

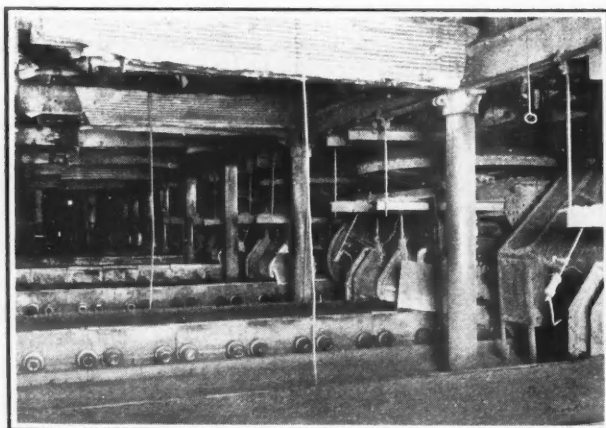
furnaces, some of the details of which are interesting. Double settlers are used, the first and larger being 8 ft. in diameter and 4 ft. deep. It is replaced on the average every forty-eight hours. A smaller settler may be replaced several times a day. Changing of settlers, however, is a simple matter, as a crane makes the shift quickly and the blast is not taken off the furnace. Slag-pot shells are crushed and re-smelted. At intervals of ten days a furnace is shut down, the end jackets are removed, and crusts on the sides are cut off with jackhammers equipped with chisel bits. The entire operation is accomplished in four hours.

No matte is tapped, the copper going with the lead and being removed as dross for matting in a special small reverberatory. A St. Joe casting wheel has been installed to take the place of the Miller machine that originally was erected. Silver bullion 0.999 fine, and pure gold are made at the Bunker Hill smelter. The Parkes process is used, and a number of novel and ingenious details of procedure might be pointed out if space permitted.

MODEL SMOKE-TREATING PLANT AT KELLOGG

In many respects the smoke-treating installation at the Bunker Hill plant is the most modern and complete in existence. It consists of a baghouse of 2,800 bags, 1,600 of which were added last year, and a fourteen-unit Cottrell treater with 64 pipes per unit, all discharging into a single stack. Normally, the blast furnace smoke passes through the baghouse and Dwight-Lloyds are served by the Cottrell, but suitable gates and bypasses are provided to permit any desired arrangement of the flow. The Cottrell can be operated either as an up-draft or down-draft treater by virtue of suitable gates. This is indicated on the accompanying sketch. A complete description would be well worth while, but I shall confine myself to pointing out a few features.

The humidifying chambers, flues, and the walls of the treater itself are made of hard-burned red brick laid in and lined with a refractory mortar composed of sodium silicate and ground quartz, half of which is crushed to 30 mesh and half to 200 mesh. Four additional coats of silicate of soda were applied where the action of the acid is most severe. Brass nozzles, directed downward in the roof of the spray chamber, have a water pressure of 250 lb. per square inch. The spray chambers are built with sloping bottoms and have settling chambers outside.



East Helena plant of the A. S. & R. Co. in Montana

Oil-fired sintering machines give a double roast

Reclaiming fine bedded material with a Hoar shovel

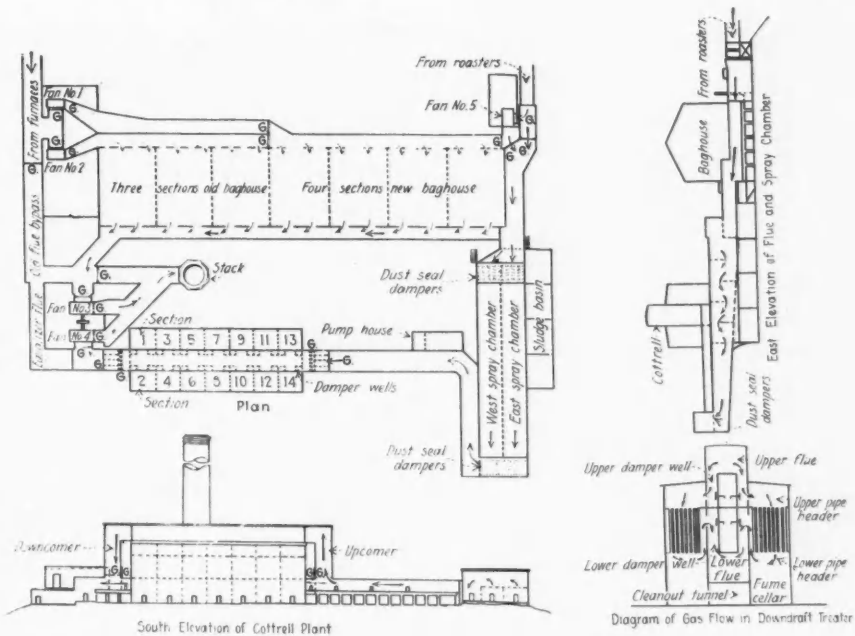
The treater itself is of the pipe and wire type, the pipes being 12 in. in diameter and 16 ft. long and made of hammer-welded seamless steel tubing. The pipes are "inclosed"; that is, they are entirely surrounded by gas, so that the temperature inside and out is the same, and condensation and consequent corrosion are obviated. The various dampers with which each section is provided are made of sheet-iron disks 4 ft. in diameter, operating on a horizontal shaft and seating on a ring of asbestos packing. These are absolutely air-tight and prevent any possibility of leakage.

Motor-driven line shafts provide for mechanical rapping of the pipes by suspended hammers striking 5 ft. from the bottom of the pipe. A novel feature is the arrangement of compressed-air jets to blow dust from the insulators and prevent short-circuits. The capacity is such that a gas velocity of only 5 or 6 ft. per second is necessary; this gives excellent clearance. As shown on the accompanying sketch, five large fans are provided to assure positive control of the smoke. M. H. Sullivan is superintendent of the plant and A. F. Beasley is assistant.

When the American Smelting & Refining Co. acquired the East Helena smelter, in about 1900, it consisted of four small blast furnaces, sixteen reverberatory hand roasters, and a small sampling mill. The furnace charge contained oxidized crude ores and 30 per cent roasted sulphides, all low in zinc. Copper ores from Butte, together with low zinc in the charge, accounted for a small matte fall; lead ore, sufficient to make 10 per cent on the charge, came from the Coeur d'Alene district in Idaho; and siliceous ores came principally from Montana camps.

Operations were comparatively simple. Gradually the crude ores were replaced by table concentrates, then by flotation concentrate, and with them the residues from the Great Falls electrolytic zinc plant. The zinc content of the charge increased. Roasting went through a period of rapid evolution. H. & H. pots, Godfrey furnaces, and Dwight-Lloyd machines followed one another. Double roasting and blast-furnace operation without a matte fall were developed. The East Helena plant was the first in the United States to try these innovations. The lead on the charge averages 20 to 25 per cent; copper is collected as a dross on the lead.

The plant is now handling 25,000 tons of lead-bearing material per month. Fine products go directly to bedding bins, and the coarse are crushed and bedded with the fines and part of the lime rock required on the blast-furnace charge. The bedding is done by hand, so as to get a good mix; a 5-ft. bed, thinner than formerly, is made, and this affords better mixing during reclaiming. An innovation that has made a material cut in costs is the use of a Hoar mechanical shovel for reclaiming the bedded material as roaster feed. The primary Dwight-Lloyds are supplied by means of electric locomotives. The initial charge, carrying 14 per cent sulphur, is passed over the sintering machines at the rate of 300 tons per machine per twenty-four hours. The bed is 4 in. thick and the sulphur content is reduced to 7



Arrangement of Bunker Hill "smoke" plant

Note the combination of Cottrell treater and baghouse. The G's indicate the location of gates by means of which the flow of gas and fume may be diverted.

per cent. The sinter is crushed, moistened, diluted with granulated slag and a little raw high-sulphur concentrate, and re-roasted at the rate of 160 tons per machine. Here the bed is 8 in. thick. The final sinter contains only 2 per cent sulphur and is in the proper physical condition for the blast furnace. Oil, the fuel for the Dwight-Lloyd machines, is used in a special burner operating with 30-lb. air pressure. Screw conveyors have been installed in the wind-boxes to facilitate the removal of cinders. Stewart grates of cast iron are used, but it is found that they must be ribbed, or warping and cracking will result, especially on the machines with the 8-in. bed. The blast-furnace charge is composed of about 75 per cent sinter, the remainder being miscellaneous ores, some limestone, and a little scrap iron.

The blast furnaces are 192 by 42 in.; the ore column is 18 ft. high, with the shaft water jacketed nearly to the top. Double settlers are used as a precautionary measure. The slag analysis is about as follows:

	Per Cent		Per Cent
Silica	23.0	CaO	15.0
FeO	41.0	Zinc	13.0

Lead is drossed in five 60-ton kettles, the dross being treated in a small special matting reverberatory. Doré bullion goes to Omaha and a 50 per cent matte to Tacoma, Wash.

The blast furnace smoke passes through a long flue to the baghouse, which is equipped with 3,600 36-ft. woolen bags. The roaster gases are humidified by means of air-water sprays to condition them for the Cottrell treater. The atomizing sprays are specially designed, using 65-lb. air pressure. The treater consists of eight units, each containing 180 6-in. pipes. The Cottrell effluent is heated from 120 deg. F. to 135 deg. by means of a coal fire at the base of the stack. In addition to increasing the velocity, the increased temperature prevents condensation in the stack and a consequent corrosion of the brick. W. J. O'Connor is general manager of the plant and A. A. Zimmerman is superintendent.

The Great Diamond Hoax

How a Colorado Desert Was Salted With Gems in 1872

By T. A. Rickard

A SPECIAL DISPATCH to the San Francisco *Chronicle*, under the heading of "Diamond Mine to Be Worked at Oroville," said: "At last the long expected call that will electrify the world and create a greater sensation than the cry of 'gold' in 1849 has gone forth from Oroville, and it is diamonds." This referred to a supposed diamond mine on the banks of the Feather River. The reporter apparently did not know that a much closer analogy was available than the gold excitement that followed Marshall's discovery in 1848; he might have mentioned the great hoax of 1872. That was more than a local affair; it created world-wide interest and is one of the best examples of mining vaudeville.

Part of the story has been told by Asbury Harpending in a little book published twelve years ago. Harpending (who died in New York on Jan. 26, 1923) was in London in March, 1872, when he received a cable dispatch from William C. Ralston, the president of the Bank of California, stating that "a vast diamond field" had been discovered "in a remote section of the United States." Before starting for San Francisco, Harpending had an interview with Baron Rothschild, who showed a lively interest in the story, which was as follows: Two weather-beaten prospectors went to the Bank of California and deposited some uncut diamonds and rubies for safe keeping; these precious stones were estimated to be worth \$125,000. The men said that they had found the gems in "a desert portion of the West." They departed quietly, but the story was told in business circles; whereupon George D. Roberts, a mining engineer of wide experience and an associate of Ralston, sought an interview with the prospectors. One of them proved to be a man that had been in the employ of Roberts. Both prospectors, named Slack and Arnold, appeared "coy and cautious"; they were "simple-minded fellows," and were "afraid to trust anyone with the momentous secret." They refused to divulge the place of discovery and declined "to part with their rights," but later "they became more amenable to reason" and expressed willingness to sell a half interest to "gentlemen in whom they had such implicit confidence." They agreed, says Harpending, "to conduct two men, to be selected by Ralston and Roberts, to the diamond fields, and allow them to satisfy themselves of the general nature of the find, but with this proviso: that these representatives, after reaching a wild uninhabitable country, must submit to being blindfolded, both going and coming back." The examination was made by David D. Colton and another, under these conditions. "More diamonds were unearthed and the party returned with rose-colored reports of the genuineness of the properties and their fabulous richness."

It was at this stage of the proceedings that Harpending arrived in San Francisco from London. He found his friends greatly excited. The two prospectors, says Harpending, made "an offer to go to the diamond fields and bring a couple of million dollars worth of stones and place them in our possession as a guaranty of good

faith." They departed. A week later they telegraphed from Reno asking that somebody meet them at Lathrop. Harpending went; he says: "I had a long wait at Lathrop, but at last the expected Overland [train] pulled in. I located the men without difficulty. Both were travel-stained and weather-beaten, and had the general appearance of having gone through much hardship and privation. Slack was sound asleep like a tired-out man. Arnold sat grimly erect like a vigilant old soldier with a rifle by his side; also a bulky-looking buckskin package." They told Harpending that they had lost one package of stones while fording a river—by the way, in a "desert" country—but that "as the other contained at least a million dollars worth of stones, it ought to be fairly satisfactory." On arrival at Oakland they handed the bag of diamonds to Harpending, who went immediately to his home, where his associates had assembled. "We did not waste time on ceremonies. A sheet was spread on my billiard table, I cut the elaborate fastenings of the sack, and, taking hold of the lower corners, dumped the contents. It seemed like a dazzling many-colored cataract of light!"

The diamonds were displayed later in open trays to the sight of the people of San Francisco. Local excitement was tremendous. Several persons went to the prospectors and bought an interest in the discovery, which, it was understood, was owned as to three-quarters by Ralston and his friends. A sample of the stones was sent to Tiffany, the jeweler, in New York, and a party of six, including Harpending and the two prospectors, proceeded thither. Tiffany reported that the sample was worth \$150,000. "At that figure, we had diamonds enough already in stock to make up a total of \$1,500,000 in hard cash." That seemed "regular velvet to begin with."

All that was needed now was to send a mining expert to confirm the value of the discovery. Henry Janin, a distinguished engineer, was engaged to make the examination; he, accompanied by three others, including Harpending, was conducted to the mine by Slack and Arnold. They proceeded to Rawlins, in Wyoming, and went from there by an indirect route over rough country to "the spot." Arnold and Slack in their zigzag course had actually brought them within 20 or 25 miles of the railroad, but Arnold assured Harpending, with a smile, that the railroad was "at least a hundred miles away." The party proceeded to search for diamonds, by aid of pick and shovel. "Everyone wanted to find the first diamond. After a few minutes Rubery gave a yell. He held up something glittering in his hand. It was a diamond, fast enough. Any fool could see that much. Then we began to have all kinds of luck. For more than an hour, diamonds were being found in profusion, together with occasional rubies, emeralds, and sapphires."

Apparently even Janin overlooked the discrepant character of the evidence, for rubies, emeralds, and sapphires are not found in the same rocky matrix with diamonds. "Mr. Janin was exultant that his name should be associated with the most momentous discovery

of the age." In two days he was satisfied of the "absolute genuineness of the diamond fields" and advised the immediate location of the adjacent ground so that "one great corporation" might have "absolute control of the gem market."

Janin's report is quoted in the *Engineering and Mining Journal* of Sept. 3, 1872. It appears in the "Mining Summary" under the heading of "Arizona." That is where the diamond fields were supposed to be, but a reference is made to "the efforts to conceal their precise location." Most of the report is given verbatim, but not the first paragraph:

"He says while at the diamond fields, there was washed of rich gravel less than, but say, three thousand pounds, or one and a half tons. This amount of work was done by Messrs. Slack and Arnold principally, the only experienced washers, assisted at times by myself and other members of the party. The total amount of work done was under, but say, four days' work of two men, of eight days' work of one man. This amount of labor produced 256 carats of diamonds, first quality, worth \$16 per carat, or \$4,096; 568 carats diamonds, second quality, worth \$3 per carat, \$1,704; 824 carats, \$5,800. Further, of rubies, four pounds, or 7,200 carats, worth 50c. per carat, but estimated at 30c.—\$2,226. Total produce of one and a half tons of gravel, \$8,026, or \$5,350—say \$5,000—per ton. The estimate was made on a conservative, commercial and selling basis, and ignored the fact that while none of the diamonds were worthless, many were large enough to be worth much more per carat than \$16. . . . The washing was done by hand in ordinary gold pans; with the assistance of even the simplest machinery (gold rockers), the results of the same quality of gravel would have been increased many-fold by the same number of days' work. One thousand tons of such gravel as this would produce \$50 per share and would more than cover the purchase price and expenses of production."

ONLY SEVEN DAYS ON THE GROUND

Then follow other estimates based on the foregoing. The report continues: "Our stay at the diamond fields was so short (we were in camp at the field only seven days), and there was so much to be done in the way of locating, surveying, and securing the property, water rights and timber lands, that it left much less time than I desired, in which to prospect and sample this tract of ground. To prospect the whole tract of nearly 3,000 acres would occupy months. I had only time to gather samples from those portions of the 160-acre block of ground which are marked in the accompanying plat. The amount of prospecting done was insignificant, and does not enable me to form a judgment as to the extent or limits either of the very rich or only moderately rich ground."

Then follow details concerning the water rights and timber, after which: "In conclusion, I would say that I consider this a wonderfully rich discovery, and one that will prove extremely profitable. That while I did not have time enough to make the investigations which would have answered very important questions, I do not doubt that further prospecting will result in finding diamonds over a greater area than is as yet proved to be diamond-bearing; and finally, that I consider any investment at \$40 per share, or at the rate of \$4,000,000 for the whole property, a safe and attractive one."

This report is open to several obvious criticisms. If the time spent on the ground was insufficient for a

satisfactory examination, Janin should not have written the final paragraph, in which he pronounced the "investment" safe for \$4,000,000. As the sequel proved, his investigation was so perfunctory that no opportunity was given to detect an abject fraud. The deposit is described as "gravel," as if it were an alluvial deposit. The panning of samples was done "principally" by the two vendors, and probably the selection of the places to be tested was left largely to them! Janin should have taken an "experienced washer" with him if he was unprepared to do the panning himself. As it was, he played into the hand of the two rascals like any tenderfoot.

The party, accompanied by Janin, went from Wyoming to New York. "In a brief space . . . all the civilized world knew that vast diamond fields had been discovered on the North American continent, had been inspected by a mining engineer of great reputation and pronounced genuine." Rothschild cabled to Harpending, who replied that "half the truth had not been told; but the diamond fields were rich beyond calculation." Indeed, it is not surprising that after Tiffany's valuation and Janin's report "every suspicion gave way to an unbounded enthusiasm."

COMPANY CAPITALIZED AT \$10,000,000

On June 30, 1872, a company with a capital of \$10,000,000 was organized in California. "Twenty-five gentlemen, representing the cream of the financial interests of the city of San Francisco, men of national reputation for high-class business standing and personal integrity, were permitted to subscribe for stock to the amount of \$80,000 each, and this initial capital of \$2,000,000 was immediately paid to the Bank of California." The men that became the directors of the company "stood as the last word in the financial and commercial world of the Pacific Coast." One of them was the representative of the house of Rothschild which became the company's agent in Europe. "The interest of Slack and Arnold was wiped out finally by a cash payment of \$300,000."

The directors dispatched a consignment of diamonds to Rothschild, and sent a party of miners and surveyors, headed by Roberts, to the diamond field. Meanwhile not a share of stock had been placed on the market, "although the excitement was intense." Roberts and his party confirmed all that had been said; he asserted that "if they had been deceived they were the worst deceived and cheated men who ever lived." They were. The package of diamonds brought back by the Janin party was valued at \$20,000, but Tiffany estimated it to be worth only \$8,000. This discrepancy was disregarded.

By that time "everything was closed down for the winter." One wonders why the company dared to leave such a treasure unprotected. Fortunately, no share speculation had been started, but handsome offices were engaged, and in it was displayed a map of the 3,000 acres claimed by the company, showing the relative positions of Diamond Flat, Ruby Gulch, and Sapphire Hollow, but omitting the site of Sucker Valley.

CLARENCE KING BURST THE BUBBLE

That significant spot was exposed suddenly on Nov. 11, 1872, when the president of the company received a telegram from Clarence King, at that time at the head of the Fortieth Parallel Survey and later the first Director of the U. S. Geological Survey, stating that the

diamond discovery was a hoax and that the ground had been salted. The telegram came from Wyoming. The directors were stunned. They held a meeting, says Harpending, and asked King to take a party to the alleged diamond deposit. Accordingly Janin and three others started immediately. King went with Janin and his party to the alleged diamond field, and showed them the evidence of fraud.

In the *Engineering and Mining Journal* of Dec. 10, 1872, the fiasco is exposed. Clarence King's report is given in full; also the second report by Janin. Apparently King came to San Francisco as soon as he had discovered the fraud; he addresses his report to the directors of the New York and San Francisco Mining and Commercial Co. in these words: "I have hastened to San Francisco to lay before you the startling fact that the new diamond fields upon which are based such large investment and such brilliant hope are utterly valueless, and yourselves and your engineer, Mr. Henry Janin, the victims of an unparalleled fraud." He proceeds to explain that he made the examination, "feeling that so marvelous a deposit as the diamond fields must not exist within the official limit of the geological exploration of the Fortieth Parallel, unknown." He was "enabled to find the spot without difficulty, reaching there on Nov. 28. . . . Our first day was devoted to the sandstone table rock, at the head of Ruby Gulch, where about all the stones collected by your parties have been gathered, and had our critical work ended with the close of this one day, we should have left the ground confident believers in the genuineness and value of the fields. My suspicions were, however, aroused early in the second day's work, and I at once determined to make an exhaustive series of prospects, of which the following are the results:

"First—A nearly uniform numerical ratio exists between the rubies and diamonds.

"Second—The gems, in nine cases out of ten, lie directly upon the hard surface of rock or an indurated crust of soil. In the exceptional cases, where I found them in crevices, there was always ample evidence that the sand or soil had been disturbed and broken up within a year.

"Fourth—Ruby Gulch, leading directly from Table Rock to Arnold Creek, and by necessity receiving the wash of the gem-bearing surface of sandstone, was found to be extremely rich in rubies at the head; but this richness, instead of continuing down the creek, as if genuine, it inevitably must be, proved to exist only in ground directly at the foot of Table Rock, where the soil was clearly disturbed, mixed and smoothed over. . . .

"Sixth—Upon raised dome-like portions of Table Rock rubies and diamonds lay upon the summits and inclined sides in position where the storms of one or two winters must inevitably have dislodged them. . . .

"Seventh—An exhaustive examination of the rock-material itself, with a field microscope, revealed no grain, however minute, of either gem.

"Eighth—In the ravines and upon the mesa near by are numerous anthills of small pebbles, mixed by the ants, and which we found to bear rubies on their surface. A still closer examination showed artificial holes, broken horizontally with some stick or small implement, through the natural crust of the mound; holes easily distinguished from the natural avenues made by the insects themselves. When traced to their end, each artificial hole held one or two rubies. Moreover, about

these 'salted' hills were the old storm-worn footprints of a man.

"Ninth—I discovered in the Table Rock three small emeralds. Summing up the minerals, this rock has produced four distinct types of diamonds, Oriental rubies, garnets, spinels, sapphires, emeralds, and amethysts—an association of minerals I believe of impossible occurrence in Nature.

"CUNNING AND ARTFUL" SALTING, SAID KING

"The result of these ten links of proof are: That the gems exist in positions where Nature alone would never have placed them; that they do not exist where, had the occurrence been genuine, the inevitable laws of Nature must have carried them. Finally, that some designing hand has 'salted' them with deliberate fraudulent intent. Furthermore, this is the work of no common swindler, but of one who has known enough to select a spot where every geological parallelism added a fresh probability of honesty. The section of the geological locality is so astonishingly considered, the 'salting' itself so cunning and artful, the filling of all the conditions so fatally well done, that I can feel no surprise that even so trustworthy and cautious an engineer as Mr. Janin should have brought home the belief he did, especially when, as his report states, he was not allowed to prospect exhaustively; nor do I wonder that your second party of ten men brought back a confirmation of Mr. Janin's opinion, since they, too, were hurried from the ground without actually testing it. . . ."

The report is signed "Clarence King, U. S. Geologist." I have not quoted all of it, because it is unnecessary to do so. King magnifies the cleverness of the deception partly to soften criticism of his friend Janin, and perhaps also unconsciously to emphasize his own skill in the detection. He did no more than any competent mining engineer should have done; the fraud was a piece of "coarse work," and should have been detected by both Janin and King after any real investigation. The reason why the "second party of ten men" confirmed Janin's first report was because they omitted, as he did, to make adequate tests, or to remain on the ground long enough to gather the necessary clues. It seems to me that the fraud *was* the work of a common swindler and that "geological parallelism" *was* distinctly lacking, for the presence of diamonds in company with three or four other different kinds of gem-stones presents a distinct geological discrepancy. The "salting" itself was so little "cunning and artful" that the diamonds and rubies were placed loosely in natural crevices, the piercing of the anthills was performed so carelessly as to be visible, and the footmarks of the perpetrators were so little disguised as to remain in plain sight for months after the fake had been concocted.

JANIN MADE SECOND "EXAMINATION"

King's report is followed by Janin's second report. It is dated Nov. 25, 1872, and gives the result of his second visit to the ground, accompanied by King. Janin says, in part: "We have examined all the points tested by Mr. King, and have made numerous additional tests, all of which go to prove that he was right in his conclusions, that the ground is absolutely worthless and not diamond-bearing, and that it has been made the field of an ingenious and infamous fraud. In company with General Colton I repeated the tests made by me on the occasion of my first visit, at points a third of a

mile distant from the 'discovery' point, where I had previously found and reported diamonds and rubies. Innumerable tests showed the ground to be absolutely barren, showing that the gems found were placed in the various samples of gravel taken, between the time they were collected and the time when they were washed. These tests were made in company with one of the original and supposed discoverers." "These tests" refers to the panning done at the time of Janin's first, and perfunctory, examination. His statement indicates that not only was the ground "salted," but that the samples likewise were doctored during the time they were being tested.

He describes in detail the confirmation of King's conclusion and then proceeds: "We gathered diamonds and rubies from the bare pieces of sandstone above, as has been done by every party visiting the ground. Here, too, the conditions of fraud are numerous and irresistible. Since I professionally examined and indorsed this supposed discovery, the responsibility of investments made subsequent to my report and the consequent losses of course rests upon me. In partial explanation of the apparent ease with which I was befooled, I must be allowed to go back to the time when I first heard of this affair, when my services were engaged. In the latter part of last May I was in New York and was called upon by two gentlemen of this city, both at present large shareholders in the enterprise and with their own means largely engaged in the same. They laid the story before me and silenced the incredulity which is naturally excited, by the statement that they themselves had investigated the matter closely; that they were assured by the original prospectors, and believed that two trips had already been made by them to these fields, at long intervals, and that each trip had resulted in the production of large values in precious stones, although their work was done hastily and with rude implements. . . .

JANIN'S EXPLANATION

"While discounting in my own mind very largely the statements of the prospectors as quoted by me, they still left me firmly impressed with the belief that such large sums had been obtained from this ground as to preclude any suspicion of 'salting'. Diamonds and rubies, both in the rough and polished state, were shown to me, and in good faith, as coming from these fields. The diamonds were, many of them, of considerable value, and were ranked as a high average quality by New York lapidaries. The diamonds picked up by the last expeditions are mostly small and worthless, and are the refuse of what was obtained by the earlier expeditions. On my way out I was told in great detail the story and adventures of the two so productive trips. I looked upon my investigation as undertaken not to determine the fact of the discovery, but to ascertain approximately the extent and value of the same. . . . Had I been allowed more time, as I desired, in which to make my investigations, it is probable that I would have detected the fraud. At the same time, it is possible that the same 'salting' game might have been kept up, and my good opinion of the property have been not only confirmed but increased . . . A further explanation of the mistaken opinions of myself and others is found in the patient, ingenious, and audacious nature of the fraud."

So ends the report; it is ingenuous, and frank in its acceptance of blame. In the same issue of the *Engineer-*

ing and Mining Journal there is an editorial article, entitled "The Diamond Swindle." It was written by Rossiter W. Raymond. Again Janin is fortunate in finding a friend ready to minimize his blunder. Raymond, King, and Janin were among the first men in the profession at that period—fifty years ago—and they were close friends. Dr. Raymond endeavors to explain "the otherwise astonishing phenomenon of an engineer like Mr. Janin, consenting, after so much preparation, to leave his work half done, and to present a preliminary, where he intended to render a conclusive report." His explanation is that Janin was "hurried away, after a single day's prospecting," and that "a great deal of clerical work developed upon him, by reason of the illness of the only other person in the party who could discharge it; and when, after all preliminaries [this refers to surveying, locating, and preparing records] were completed, the work of prospecting actually began, it was continued but a single day, before the sick man ["a representative of the capitalists"] peremptorily insisted on being taken away, declaring he should die if he remained longer in the wilderness." These facts, says the editor, "come to us on excellent authority."

RAYMOND "KIND BUT NOT CONVINCING"

Then follows a reference to King's report, with the remark: "It now seems beyond doubt that the locality (which is in Colorado) was skillfully 'salted' with small stones, while large ones were from time to time introduced into the samples taken for testing, during the process of washing. That Mr. Janin, like most of his profession in this country, had had no practical acquaintance with the geology, topography, and special conditions of diamond fields was no disgrace to him. That he did not suspect a fraud, even, was natural enough. He was sent to report on the probable value of a discovery which had furnished precious stones for more than a year; his employers did not request him to test its genuineness, but to determine its extent."

This is "kind, but not altogether convincing. He did not remain on the ground anything like long enough to "determine its extent"; and an engineer is expected, of course, to satisfy himself of the "genuineness" of a deposit before he begins to value it in terms of millions of dollars. Raymond seems to appreciate the weakness of his apology; for he adds: "But when all is said, the fact remains that an acute, experienced, and upright man allowed himself to be outrageously deceived, in a case involving his own hard-earned reputation, and an enormous pecuniary interest. . . . Of course, this matter will be laid at the door of 'science'—but most unfairly. The combination of circumstances that deceived one of the shrewdest experts on the Pacific Coast might have misled any scientific man in the country, who did not absolutely disbelieve all men and all superficial phenomena."

CAVEAT EMPTOR!

To which I would remark that an engineer when about to examine a mine should write *Caveat emptor* on the first page of his notebook. Raymond senses this, for he continues: "But the scientific spirit is that of entire skepticism and fundamental investigation. Mr. King's work was scientific, yet he confesses that if his examination had ended with the first day, he would have been convinced as Mr. Janin was. It was his continued investigation that brought out the truth; and

it was Janin's unfortunate failure, through causes apparently beyond his control, to make such an investigation, and his fatal error in consenting to give a 'preliminary opinion' that cost him so dear."

"A LESSON FOR MINING ENGINEERS"

If King had gone all the way to the place of the supposed discovery and had spent only one day there, he would not have done his work as a geologist in a "scientific" manner. The methods of science are thorough and sincere. Raymond proceeds to state that "this is a startling lesson for mining engineers." He refers to previous editorial warnings against the trickeries of the promoter's trade, and ends with the regretful statement: "Henry Janin's mistake may well teach us all humility and caution." With this I concur heartily.

In after years even Raymond himself was grossly deceived in his estimate of the ore in the Chrysolite mine at Leadville, and others of us at some time or another have been barely fortunate enough to detect fraud in time to prevent a public fiasco. Henry Janin survived the blow to his reputation and regained his standing in the profession long before he died, on Jan. 6, 1911, nearly forty years after the events that I have described. The moral of his story is that an engineer should avoid expressing a premature opinion; he should write no report until he has ascertained the facts; and, more particularly, he should be intensely skeptical of any alleged new diamond field in the United States, or elsewhere.

RALSTON AND ASSOCIATES ONLY LOSERS AS A CONSEQUENCE OF THE FIASCO

The party that accompanied King and Janin in this final examination returned to San Francisco, and on Nov. 25 the facts were given to the press, "that the diamond fields were a fraud, and that everyone had been taken in." An investigating committee was appointed. A disappointed confederate gave useful evidence. It appeared that Slack and Arnold had bought a parcel of the small diamonds used for drilling; a dealer in London identified them as having been purchased from him a year before. This information ought to have been available sooner, for it was based on the examination of the consignment sent to Rothschild for sale some time in July. The subscriptions of the twenty-five shareholders, aggregating \$2,000,000, were returned to them. The only loss incurred was the money paid to the perpetrators of the fraud and the expenses of the various expeditions, all of which were met by Ralston and his associates. The general public did not lose a cent.

DIAMONDS CAME FROM SOUTH AFRICA

The diamonds used in the salting came from South Africa and were bought by Arnold in London. The stones were of the inferior kind used for glass-cutting, diamond-drilling, and other utilitarian purposes. It must be remembered that in 1872 not much was known about diamonds or their mode of occurrence. The diamantiferous deposits of South Africa were discovered in 1869 and the mining of them may be said to have started in 1871. Before that the chief source of brilliants was Brazil, where the diamonds are found in sand and gravel derived from a conglomerate of micaceous sandstone. Perhaps that was why Arnold selected a sandstone for the scene of his fraud. The

South African diamonds are found in a volcanic plug, which consists of a breccia of several rocks, chiefly periodotite. Sapphires are found in Montana and Canada in dike-rocks, such as lamprophyre, andesite, and syenite. Rubies and emeralds are found in pegmatite.

Several interesting discrepancies are to be noted in the details of the story. Harpending says that Slack and Arnold received "approximately \$600,000," and that the "salting" was done with stones that cost them "about \$35,500." He says that they received "finally" a cash payment of \$300,000, but he does not say when or how they were paid the second \$300,000. On the other hand, the first parcel of diamonds, which was deposited by Slack and Arnold at the Bank of California, was said to have been worth \$125,000. Next the consignment sent to Tiffany was estimated by him to be worth \$150,000, whereupon the diamonds "already in stock" were given a value of "\$1,500,000 in hard cash," as Harpending asserts. Obviously, the value of the stones was absurdly overrated from start to finish, and Tiffany's appraisal was largely to blame. He apparently did not know how to appraise uncut stones, his experience having been only with cut gems. His name even then carried much weight.

It is one of the humors of the swindle that the discarded of the diamond trade, bought for \$35,000 only, should have sufficed to create an estimate of more than \$1,500,000, for it must be remembered that all the stones were not recovered. Some of them must still remain where they were placed, in Colorado, a few miles south of the Wyoming boundary. In Harpending's tale he describes the "dazzling, many-colored cataract of light" that he emptied on the table from the bag that the prospectors brought to San Francisco. Uncut stones are not "dazzling," or even brilliant; they are dull, like pieces of ground glass. Evidently imagination entered into play. That some of the diamonds were cut stones is likely; indeed, it was part of the crudity of the swindle that one or more cut stones were used in the "salting." Harpending says that King obtained his clew from the finding of a cut stone by a German member of his staff, and there is evidence to corroborate this statement, the man that detected the evidence of the lapidary's art being a certain Schmidt, who had had some experience with gems.

ARNOLD PAID \$150,000 IN FINAL SETTLEMENT

Suspicion of the complicity of some of the promoters was aroused at the time, but there is every reason to accept Harpending's assertion that they were dupes, not conspirators. Slack, it seems, received only \$30,000; he disappeared, and no trace of him was ever found. Arnold went to Kentucky, where he settled down to enjoy a quiet life. When the fraud was detected a lawsuit was started against him in the local court, to which he replied by denying the "salting" and asserting that if there had been any it must have been done by the "California scamps." He brought forth Janin's report and Tiffany's appraisal in proof of his own honesty. His neighbors thought him a fine fellow and supported him cordially. In the end, after sundry negotiations, he compromised and surrendered \$150,000, in consideration of immunity from further litigation. But he did not live long to enjoy his ill-gotten gain; he was shot in an altercation on the street and died soon afterward, at the end of 1873.

A New Method of Preparing Briquetted Mineral Grains for Microscopic Study*

Redmanol, a White Resin, Found Superior to Sealing Wax as a Binder

By R. E. Head

Microscopist, Intermountain Experiment Station, U. S. Bureau of Mines, in co-operation with the Metallurgical Research Department of the University of Utah, Salt Lake City, Utah



R. E. Head

THE advantages to be derived from the microscopic study of crushed sulphide minerals in polished sections are well known to metallurgists and geologists, especially to those whose work has brought them in contact with many of the problems incident to the utilization and treatment of the complex ores. Although many of the questions regarding the mineralogy and complexity of mineral

association can be answered by a carefully conducted study of polished ore specimens, it often becomes necessary to examine the mill concentrate, middling, or tailing, to check up on the following: (a) The degree of separation resulting from crushing, (b) to find and identify minerals that are present in relatively small quantities in the ore, and (c) to determine, by microscopic measurements of surface area, the relative abundance in which the several minerals comprising a particular product occur.

Sealing wax has been used¹ as a binder in the preparation of mineral briquets for microscopic study, with fairly satisfactory results, but is not hard enough for producing highly polished sections, nor is it resistant to acids and other reagents commonly used in identifying minerals in the polished condition. The preparation of briquetted sulphides in a form superior in all respects to those composed of sealing wax can be accomplished by the use of redmanol. Redmanol is a rather finely powdered resin of a creamy white color, which melts at a temperature of 104 deg. C., forming an amber-hued, viscous mass. It does not deteriorate with age, and so may be kept indefinitely. Its low melting point and keeping qualities, coupled with the fact that it is readily transformed into a hard, durable body, similar to bakelite, by the application of heat and pressure, makes it an excellent binder for use in preparing mineral briquets suitable for microscopic examination and study.

Excellent briquets have been obtained by mixing the redmanol and sulphides in the proportion of three grams of resin to ten grams of mineral grains or concentrates and subjecting the mixture to heat and pres-

sure in a suitable mold. The detailed procedure is as follows:

Three grams of redmanol are weighed out and placed on a sheet of paper. The lumps are broken with a spatula and ten grams of mineral grains are added. The ingredients are thoroughly mixed by rolling and turning over several times with the spatula. A Plattner diamond mortar (a blowpiping accessory) makes a satisfactory mold with but slight change in its form. The lower part of the coupling should be enlarged by turning on a lathe, the cut being started at a point near the center and gradually increased in depth, resulting in a cone. To produce a perfectly smooth surface, the mold must be of hardened, highly polished steel. For the briquets in question this is not absolutely necessary, since the coned form of the finished briquet permits easy expulsion, even though there is a slight tendency for it to adhere to the surface of the mold, so the absence of a perfectly smooth surface is in no way detrimental. A circular cardboard washer is fitted into the base of the mold, the coupling placed, and set on a hot plate, where it is heated to a temperature of 104 deg. C. The pestle, or plunger, is placed beside the mold, and a disk of the same diameter as the pestle is made from thin cardboard. When the mold and pestle have attained the correct temperature, the mixed charge of redmanol and ore particles is poured into the mold and permitted to stand for five minutes, when the charge will be fused and settled. The paper disk, or wad, is then placed on top of the melted charge, and the pestle inserted and pressed into place. The mold is permitted to remain on the hot plate for another five minutes, after which it is removed with tongs and placed in a large vise. The jaws are quickly brought together and tightened by hand, which exerts a pressure of about a ton on the pestle. The mold is left in the vise until cool, when the briquet is removed by tapping the pestle with a hammer. The use of the two paper disks prevents the fused charge from adhering to the pestle and to the bottom of the mold, the slight coning of the sleeve permitting easy removal of the finished briquet.

A briquet so made will be round, $\frac{3}{4}$ to 1 in. thick and approximately an inch in diameter, and will contain several thousand mineral grains. It may be ground and polished by the methods used in preparing an ordinary polished section of rock or ore.

Sections of practically any size or shape may be prepared in suitable molds, so that provision for sizes or shapes that will fit in the holders of mechanical polishing machines can be readily made. The method described will be found convenient for ordinary purposes, but where extensive work of this kind is to be carried on, the expense of hardened and polished molds and a heated hydraulic press would be justified and productive of better results.

*Published by permission of the Director, U. S. Bureau of Mines.

¹See Bureau of Mines Serial 2,257, June, 1921, "Quantitative Microscopic Determination of Chalcopyrite, Chalcocite, Bornite, and Pyrite in a Porphyry Ore," by R. E. Head.

Briquets prepared using redmanol as a binder possess the following desirable characteristics:

1. They will stand considerable heat and are practically unaffected by the acids and reagents used in etching and determining the various sulphide minerals.
2. The mineral grains are firmly held and do not pull out during polishing.
3. Only a slight tendency exists toward the formation of rounded surfaces on the individual grains, and the relief produced during polishing is slight owing to the hardness of the binder.
4. Briquets may be made to conform to any practical size or form to suit the needs of the operator.
5. Sections prepared in the manner described can be highly polished, and are of convenient size and shape for microscopic study.
6. But little more time is required for their preparation than when sealing wax is used, and the results obtained are superior.

Other information than that noted in this article may be obtained through the microscopic study of crushed material, and investigations may be extended to include the study of crushed non-metallics. Properly made briquets of crushed gangue minerals may be sawed and made into thin sections by the usual methods. This would be a convenient method of ascertaining their nature and distribution in concentrates and other mill products.

The briquetting method of preparing crushed material for microscopic study is applicable to a variety of substances, among them being sponge iron, mixtures of metallic chips or particles, bits of wire in either cross or longitudinal section, and, in general, in the mounting of mineral or metallic specimens of small size. Other applications of the method will be suggested by the needs of the mineralogical or metallurgical laboratory.

Ore Magmas Versus Magmatic Waters

By J. E. Spurr

The gold-quartz veindikes of Porcupine, Ontario, carry locally a marked amount of feldspar; this is albite, an analysis of which gave soda 10.37 per cent, potash 0.90 per cent.¹ The wall rock of these veins is much altered to the potash mineral sericite, whereby the original potash content of the wall rock schist is increased. Specimens of unmineralized schist in the Hollinger mine showed respectively potash 1.79 and 1.06 per cent; soda 0.82 and 1.32 per cent. The wall rocks of the veins showed, respectively: potash 3.62, 3.48, 4.04, 0.93, 4.24, and 0.31; and 1.12, 1.04, 1.16, 0.59, 1.35, 0.67 soda.² The average of the unmineralized schist is potash, 1.42, soda 1.07; of the altered wall rock, potash 2.77, soda 0.99.

In the similar gold-quartz veins of Victoria, Australia, albite is met with in many places, and in some, as at Ballarat, "is a prominent constituent of the reefs."³ No potash feldspars are reported. Yet the alteration of the wall rocks shows "considerable increases in the percentages of carbon dioxide and potash, and the marked reduction of the amounts of water, titanium dioxide and, in places, of soda."⁴

The gold-quartz veins of California carry in many cases albite, never potash feldspar. The typical wall-

rock alteration involves replacement, extending a few feet or a few inches from the vein: the principal feature is the development of lime-magnesia-iron carbonates with much sericite.⁵ This results in an increase of potash, together with lime and carbon dioxide, and a decrease of soda, magnesia, and silica.⁶ In the alteration to sericite, "orthoclase is almost always more resistant than the soda-lime feldspars."⁷

These considerations show that in Ontario, in Victoria, and in California, the gold-quartz veins (which are of the same standard type in all these regions) represent the crystallization of a chemically different solution from that which has altered the wall rock. The vein (veindike) solution was sodic; the solutions (waters and gases) which altered the wall rock were potassic. The confinement of the potassic wall-rock alteration to the immediate walls of the quartz-veins, however, shows that the solutions which altered the rocks really emanated from the veins. They were high in potash, in water, in carbon dioxide, and in fluorine; but not in soda, or, indeed, in silica, the distinguishing elements of the solution out of which crystallized the quartz veins. Evidently, therefore, the wall-rock alterations were accomplished not by the vein-forming magma, but by solutions, gaseous and perhaps liquid, which were excluded from the gold-quartz magma on crystallization.

Canadian Mineral Production \$209,516,465 for 1924

Revised estimates of the mineral output of Canada made by the Dominion Bureau of Statistics show a total value for 1924 of \$209,516,465. This has been exceeded in but three previous years—1923, 1920 and 1918.

Primary metals reached a total value of \$102,980,000, an advance of \$18,590,000 over the total for 1923; non-metallic minerals and structural materials showed a lower total value than in the preceding year at \$106,530,000, a loss of \$23,150,000, due mostly to the loss in production of coal.

Gold production reached a new high level at 1,516,360 oz., valued at \$31,345,941; production from Ontario mines was 1,242,029 oz. Silver bullion was 1,640,000 oz. higher at a total of 20,243,846 oz., valued at \$13,519,043; about half the production was from Ontario mines and most of the rest from British Columbia ores. Nickel production advanced 7,130,000 lb. to 69,586,759 lb. Copper production reached a total of 106,350,730 lb., or 22.4 per cent above the 86,881,537 lb. of 1923.

Lead established a new high record at 177,756,076 lb. Zinc also reached a new high level of 98,788,667 lb. including 54,880,000 lb. of refined zinc produced at Trail and 43,900,000 lb. estimated as recoverable from zinc ores exported for treatment. Sales of cobalt and its compounds were well maintained throughout the year, but white arsenic dropped off 1,800,000 lb.

Asbestos shipments were slightly less than in 1923. Production of natural gas indicated a slight gain both in quantity and value. Gypsum sales were greater than in the previous year. The quantity of salt sold was greater, but the reported sales value was slightly lower than in 1923. Cement sales declined \$1,600,000 in value to \$13,445,156. Lime sales were lower at \$3,062,450. Brick, tile, stone, sand, and gravel sales were valued at \$16,806,113, compared with \$19,420,112 in 1923.

¹A. G. Burrows: Thirty-third Annual Report, Ontario Department of Mines, 1925. p. 42.

²*Op. cit.*, p. 50.

³*Economic Geology*, Vol. XVI, No. 2, p. 99.

⁴*Op. cit.*, p. 89.

⁵W. Lindgren: "Mineral Deposits, 1919," p. 572.

⁶*Op. cit.*, p. 554.

⁷*Op. cit.*, p. 557.

Useful Operating Ideas

Lining Tunnels With Concrete

By James E. Harding

Casilla "B," Antofagasta, Chile

Almost as important as any of the work of tunnel driving is the placing of the support or lining to prevent cave-ins and groundfalls. Such lining is generally constructed of timber, steel, or concrete or a combination of two or more. Under present conditions, concrete plays an important part in tunnel support, on account of the cheapness of its initial construction, ease of handling and placing, and its permanence and strength.

The cycle of operations is first to drive the tunnel, timbering where necessary. When placing the lining, the section is enlarged and retimbered. This enlargement and retimbering must be of such dimensions as to permit of placing the forms so that the exposed wall of concrete will conform to the section of the finished tunnel. Where the work is done in this way it amounts

is necessary. Recently I was planning the work of tunnel driving on a project which entails more than seven miles of tunnel. In connection with this I have worked out a projected system of lining which I believe is practicable and which, if successful, will result, I think, in important economy. The basis of the system is to simplify the work so far as possible, to do away with the use of forms to a considerable extent, reduce the amount of excavation necessary, cut down the amount of ground which must be opened up at any one time, eliminate secondary timbering, and increase the speed of the work.

Unfortunately, in designing the support for underground work one cannot know even approximately the amount of weight that must be supported. The projected method comprises three different weights or designs of lining. The lightest structure corresponds approximately in strength to that of a tunnel set constructed of 8x8-in. timbers; the middle-weight struc-

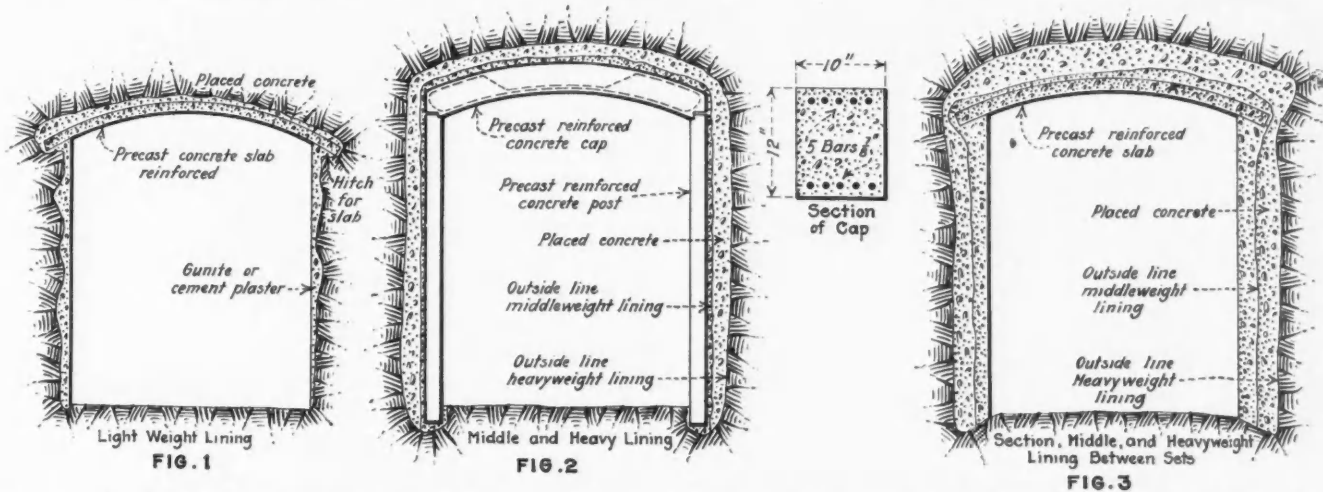


Fig. 1—Light-weight tunnel lining. Fig. 2—Middle- and heavy-weight tunnel lining. Fig. 3—Section showing lining between middle- and heavy-weight tunnel sets

practically to driving the tunnel twice, as well as timbering it twice. A much larger section than desirable must also be excavated to allow for the supporting timbers while concreting is being done. The timbering must be constantly moved and shifted as the work is in progress, so as to place forms and concrete. The danger of opening up and supporting on temporary timbers the large section of ground necessary while the work is under way is an important consideration. In so far as I have had opportunity to observe such work, it has consisted of repeated operations. Men work under cramped conditions and spend a far too high proportion of their time in placing forms, shifting timbers, and moving gear instead of actually placing concrete. All of this misdirected labor must be paid for and is reflected directly on the cost sheet of such work.

Assuming a tunnel of 11x11 ft. in cross-section, the cost figures which I have on this work range from \$80 to \$275 per foot of lining. The final cost per finished foot totals an impressive figure if much concrete lining

structure corresponds to 10x10-in. timbers, and the heaviest corresponds to 12x12-in. timbers. All are to be placed on 5-ft. centers and sides and back are to be lined with either 2- or 3-in. plank lagging. A concrete casting plant is to be established at some convenient place as near as possible to the tunnel. Three different castings are necessary, with an equal number of forms. It will be necessary to have a number of forms for the different shapes. The three shapes are the bent steel reinforced concrete slab shown in Fig. 1; the bent steel reinforced cap shown in Fig. 2, and the steel reinforced post shown in Fig. 2 and Fig. 3.

As shown in the cross-section, Fig. 2, the cap, with its reinforcing, is equal in strength to a 12x12-in. Oregon pine cap, but it weighs 1,000 lb. Getting such a weight into place on the post will be troublesome. Several methods for avoiding this difficulty have been considered. One is to cast the cap in two sections, which extend from post to post and are bolted together after placement; another is the design of a machine

to lift the cap into place, and a third is to substitute a bent 7-in. 20-lb. I-beam for the concrete cap. It is proposed to make the posts 6x10 in. in cross-section with three reinforcing bars and the curved slabs 4x10 in. in section, with chicken-wire reinforcement to prevent breakage in handling. The longitudinal dimension will be made to suit the dimensions of the tunnel. None of the dimensions suggested are of importance, nor is the amount of steel to be used in reinforcing, because in a specific case all of the members would be designed to meet the given conditions. I would suggest, however, that the slabs be cast slightly longer than actually required, so that they will fit normally where there is an overbreak and can be chipped off at the ends where the ground is hard and hitches must be cut.

When the casting plant has produced and cured the necessary concrete castings, the work of placing the lining can proceed. The design in Fig. 1 is suggested for lining to be used in ground which will stand without timber, but which must be supported later. Before placing any lining, the walls are to be trimmed up and all loose rock must be removed. At the upper corners of the tunnel a continuous hitch is to be cut. For the work of hitch cutting, it will probably be cheaper and faster to provide two compressed-air-operated riveting hammers with moils. The concrete slabs are placed in the hitches, aligned, and, as each slab is placed, the space between the slab and the roof is filled with concrete. This finishes the roof. For the walls a thin coating of gunite on chicken wire, or cement plaster, can be used. In such ground the walls need little, if any, support, and a small amount of concrete filling in the corners under the slabs will generally be sufficient.

Figs. 2 and 3 show the middle-weight and heavy-weight lining designs. The same-sized sets are used in both cases, and the strength of both types depends upon the weight of the concrete to be placed later between the sets. The middle-weight lining is to be used in medium ground, which will permit the tunnel being driven ahead of the support. In this case the sets are first installed, blocked, and aligned. Then the filling along the walls between the posts is placed to the height of the top of the posts. On this wall as a base, the same slab shown in Fig. 1, in light lining, is placed, and the space between the slab and the roof is filled with concrete as in the case of the light lining.

For heavy-weight lining the same members are used as in the middle-weight lining and the same method of placing the remainder of the concrete is followed. It is intended to use this design for ground which must be timbered close to the face while the tunnel is being driven. In case of very bad ground, the sets will be placed on 2-ft. centers. In very bad ground it may be difficult to align the sets when first placed, but if they are not properly aligned, they can be moved later and jacked into line. Placing the concrete ring between the sets will be done in accordance with ground conditions.

Facts About Steam Shovel Mining at Jerome

In some ways steam-shovel mining at the United Verde, in Arizona, is an old, though interesting story. A brief survey, however, of changes in methods that have been made from time to time as the work developed may show some things of interest.

The first change, considered chronologically, was in the size of dump cars. Originally ten Western air

dump cars of 20-cu.yd. capacity were purchased for the stripping operations. These were later remodeled at the United Verde shops into 26-cu.yd. cars and twenty new cars of the same type but of 25-cu.yd. capacity were installed. The 25-cu.yd. car has since become standard, and has been installed also at the Copper Queen mine, at Bisbee. On the Mesabi range, in Minnesota, where the surface is almost flat, the 30-yd. size is preferred by the largest operators.

The reasons for the change in the mountain sections of Arizona from 20-yd. to 25-yd. cars are explained as follows by J. C. Perkins, superintendent of steam shovel mines at Jerome:

"A five-car train of 20-yd. cars with 100 cu.yd. capacity occupies 150 ft. of track and weighs when empty 130 tons. A four-car train of 25-yd. cars has the same cubical capacity, occupies 30 ft. less track, weighs 10 tons less, and at the same time is about the proper tonnage for the locomotive to handle."

It originally was thought that steam-shovel operations offered the only method of recovering the ore in the fire zone. Subsequently, as the work developed and further study was made, a plan was evolved whereby the ore could be recovered at much lower cost than it first was thought possible, by combining shovel work with the mill-hole or "glory-hole" system. After about 6,000,000 cu.yd. has been removed down to the 200 level, at an elevation of 5,275 ft. the remainder of the orebody will be removed down to the 500 level by mill-hole methods. Ore will be discharged from the dump cars into raises leading down to underground workings a thousand feet below, where it will be handled in the usual way. This plan will avoid the necessity of removing large additional quantities of overburden so as to work the shovel to lower levels. Mr. Perkins says:

"Recent work had shown a well-planned mill-hole system to be a serious competitor of shovel work in the matter of costs, except in the fire areas, once the waste directly over the ore has been removed. The mill-hole has the advantage of flexibility over the steam shovels in regard to tonnage requirements, as the cost per ton for smelter requirements of 500 tons of ore per day would be little higher than when 3,000 tons per day are desired. On the other hand, when the steam-shovel output falls below 1,600 tons per shovel-shift, the cost rises very quickly. Another deciding factor in favor of the mill-hole is that steam-shovel ore for the smelter and stockpile material for Hopewell can be handled much more economically through the mine transfer and Hopewell tunnel than over the hill via the V. T. & S. R.R.

"The proposed limits of the present shovel pit are based on the comparative costs of moving ore and waste by steam shovels and mill-hole operations. Whenever the cost of mining one ton of ore by steam shovels, plus the cost of stripping, exceeds the cost of underground mining, the economic pit limit has been reached.

New Mexico coal was first used on both locomotives and shovels. Subsequently locomotives and afterward shovels were changed over from coal to oil burners.

It originally was estimated that 3.5 bbl. of crude oil would be equivalent to one ton of coal, and the change was made on this basis. Actual practice, however, shows that 2.7 bbl. of oil are equivalent to a ton of coal. The amount of coal used per locomotive has been 3.5 tons per eight-hour shift, against 9.5 bbl. of oil for the same period. With coal costing more than \$11 per ton, on the tenders, and oil at \$2.15 per barrel in the tender tanks, the saving was more than \$20 per shift.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Basic Slag as Fertilizer

THE EDITOR:

Sir—The following paragraphs from the *Christian Science Monitor* are of interest to smelters having slag in excess of current demand:

"Comprehensive tests relating to the manuring of the clover crop have been carried out at the Saxmundham experimental station in Suffolk. In these trials, detailed records have been kept, both of the yields of clover and of the subsequent wheat crops grown, under various methods of manuring the clover crop.

"The plot which received no manure gave a yield of 39 cwt. per acre of clover hay and, in the following year, grew a crop of 19.7 bushels of wheat per acre. A second plot of clover was dressed with 10 cwt. per acre of 30 per cent basic slag. The returns from this section were 53 cwt. per acre of clover hay and 31.7 bushels of wheat per acre, respectively.

"On another plot 4 cwt. of 30 per cent superphosphate was applied to the clover, with the result that the yield of clover amounted to 56 cwt. per acre and the subsequent yield of wheat to 25.4 bushels per acre. At the market prices prevailing today, both these manurial dressings would prove very profitable indeed.

"These results were obtained on land of a distinctly heavy nature. On soils of a lighter type, the use of potash manures, in addition to the phosphate dressings, has given excellent results."

With regard to the Suffolk plots mentioned, which received a dressing of soda nitrate, the Rogue River plots yielded about the same increase from nitrate applications. Treated with raw sulphur, however, these beds far surpassed the nitrate sections. Refined sodium nitrate from which all sulphates had been removed did not influence yield beneficially, though it does cake the ground surface, at the same time increasing detrimentally the soda constituent of alkali soils.

Raw nitrates as exported from Chile enhance yield from neutral or acid soils to the extent of the residual sulphates which these nitrates contain. Continual experimentation with check plots for each soil type should be attempted.

In the issue of April 25, under the caption "Pyrites as Fertilizer," a correspondent questions the benefit to be expected from addition of iron to cultivated lands. The discoveries with regard to sulphur and iron dressing applied to soils as fertilizers were empirical. I believe there is no disposition to combat any theory. I have seen all iron drillings and filings carefully swept from a machine shop floor by an orchardist who dumped them in even proportions about his apple trees. His may have been an exceptional soil, but he thought he was doing good. I have had no direct word from Bohemia for several years, but twenty years ago no iron turnings or filings were discarded. They were converted into sulphate and applied to the soil.

In Oregon, full reports are available from the Agriculture College at Corvallis. Iron sulphate treatment

of the soil runs with magnesium sulphate at the head of the list. Pyrites, owing to slower action, only about doubles the yield of alfalfa, and it has not been recommended for this reason in competition with sulphur, where the latter is cheap. No harmful results have been reported due to addition of iron or pyrite to soils. Phosphate of iron forms only in soils deficient in sulphur. Where chlorides are present, the addition of sulphur should in theory release both the phosphorus and the iron for use of plants. F. W. CARNAHAN.

Medford, Ore.

Troubles of Mining Men

THE EDITOR:

Sir—In your issue of May 2, the three articles under the head of Discussion are particularly good. The reference by Mr. Brockunier to the age limit is something that should be elaborated; it is not a good thing for any corporation to lose able-bodied, experienced men.

The age limit as applied by American corporations is almost tragic. It does not exist in other countries and it would surprise some people to know that many gray-haired men have had to seek employment outside of the United States to maintain themselves and their families. In Mexico it is only at the American-owned mines where they are not wanted.

The absorption of smaller mines, the shut downs due to exhaustion of ore and to a decline in the market let out men in official position, many of whom find it very difficult to get other employment. A sensitive, educated man under one who has been brought up barefoot across the sea or a clean-living man sent to an isolated mine where the moral code does not prevail is another cause of a desire to change environment.

Perhaps 90 per cent of the failures in mining are due to having non-mining men and youngsters on top. Another source of trouble is arbitrary orders from the New York office. A pockety mine and instructions to do no dead work but to keep in ore and spend no money otherwise mean an end to the enterprise. The selection of prospects from which we must get our future mines is a most difficult and risky piece of business.

Prospecting has nearly ceased, because it is rarely profitable; the easy things are gone and venture money has been so abused that it is no longer available. It now requires a different class of men, those who can make a careful study of local geology and who have money enough to get away from surface conditions. It should be in the hands of experienced men only. It took Stratton, in Colorado, twenty years to get the Independence. Mr. Parker grubstaked Mr. Lockhart the same number of years to get the Florence in Goldfield. Another man, after more than twenty years here in Chihuahua, is now able to get out. Twenty or more years of hardship and privation; then a luxury that has not been prepared for and cannot be appreciated; better some business and a good home in a town or city in the United States.

Chihuahua, Mexico.

H. H. TAFT.

News of the Week

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Summary

ELECTRIFICATION of the Soudan mine on the Vermillion range in Minnesota has just been completed by the Oliver Iron Mining Co. Pumps, hoist, compressors and locomotives are run by electric motors.

Operating profit of \$400,000 is reported by the Silver King Coalition Mines Co. in Utah for April.

Total sales of concentrate from the Joplin-Miami zinc-lead district have averaged \$1,000,000 weekly during the year.

Current exploration in the Michigan Copper Country indicates optimism as to the future of the copper industry.

Shares in Rand gold mining companies languish in London on account of the lost gold "premium."

A new record for lead production—16,684,394 lb.—was made by the Consolidated Mining & Smelting Co. at Trail in April.

A dark picture for the copper smelters is painted by the A. S. & R. Co. in connection with the Carson patent appeal.

A central power plant to serve its twelve concentrating plants is being built by the Commerce M. & R. Co. near Cardin, Okla.

An effort is to be made by the Mexican government to compose the difficulties of the Guanajuato R. & M. Co., which is on the verge of suspending operations.

Successful sulphidizing and floating of lead carbonate ore is announced by the Shattuck-Arizona Mining Co.

Silver King Coalition Netted \$1,788,956 in 1924

Best Year in History—Earnings for April, 1925, About \$400,000—Big Ore Reserve

The year 1924 was the most prosperous in the history of the Silver King Coalition Mines Co. of Park City, Utah. The greatest tonnage was marketed and net profits were the largest. Notwithstanding the heavy withdrawals from the company's ore reserves, blocked out tonnages are even greater now than at the beginning of the year, according to the annual report for 1924. In addition to having paid \$794,261 in dividends during 1924, bringing the grand total of disbursements for the mines embraced within the company's estate up to \$21,813,170, the company expended \$961,073 for the stock control of the Silver King Consolidated Mining Co. Net earnings of the company totaled \$1,788,956.13.

Available cash assets of the Silver King Coalition Co. at the date of the annual meeting aggregated \$2,000,000. Net earnings for the first quarter of the current year, after deduction of all smelting, railroad, mining charges, and reserves for taxes, represent a sum substantially in excess of \$1,000,000. April, the first month of the second quarter, saw the company's income the largest in its remarkably profitable past. Net earnings for April, it is said, exceeded \$400,000.

Officers and directors were reelected. A resolution commending M. J. Dailey, general manager, for his services was adopted. Metal production for the year was as follows: 34,784,273 lb. of lead;

Joplin-Miami District in Better Position

TOTAL sales of concentrate from the Joplin-Miami zinc-lead district since Jan. 1 have averaged \$1,000,000, according to E. H. Wolf, mine operator.

Opinion in Joplin is that the district is now in a stronger position than at any time in its history, due to the strength of the many new companies that have located there recently. Formerly, most mine owners were forced to sell their week's output on Saturday of each week to meet the payroll and current expenses. The financial strength of the new companies, which include some of the largest in the industry, enables them to carry the ore until the market is more to their liking. This has been a stabilizer and has had an effect in strengthening prices.

2,551,104 oz. of silver; 3,289 oz. of gold; 1,344,220 lb. of copper, and 132,772 lb. of zinc, which brought to the company a net smelter return of \$3,409,075.45.

Fire at Mayo, Y. T.

On Sunday, May 10, fire destroyed the Letourneau Hotel and half a dozen other buildings, at Mayo, Yukon Territory. Only the strenuous efforts of a bucket brigade prevented the silver camp from being completely wiped out, as the one fire engine in the camp was "out of commission."

Tonopah Premier Mining Co. Has Unusual Financing Scheme

Will Pay 100 Per Cent on Special Shares Before Dividends on Regular Common Stock

The Tonopah Premier Mining Co., of which Albert Silver is "operating director," has acquired a group of ten claims lying north of the Mizpah Extension Mining Co.'s ground in the Tonopah district in Nevada. The geological conditions indicate a reasonable expectation that the ore-bearing formations underlie the cap rock that forms the surface; and a shaft is to be sunk if and when adequate funds are available.

The former owners of the property have taken stock in the new company in exchange for the claims and this stock is so held that it cannot be transferred or sold for one year. The owners say frankly that "they are willing to take a chance on losing the property, and having worthless stock, if the property does not prove up." In order to raise money they have agreed to an issue of \$150,000 of Class A common shares on which a total of 100 per cent dividends must be paid before any disbursements are made on the regular common stock of the kind that they hold.

The prospectus of the company says: "No one knows how big a producer of gold and silver the Tonopah Premier property may prove to be, but this much is certain: that no money will be spent except for necessary labor and supplies, and no salaries will be paid except to one operating official, until after the property is developed beyond the prospect stage."

Oliver Iron Mining Company Finishes Soudan Electrification

Large Investment in Replacing Old Steam Plants—New Hoists
and Pumps—Concrete Shaft Lining

THE electrification of the famous old Soudan mine at Tower, Minn., is complete. The mine, on the Vermillion range, is operated by the Oliver Iron Mining Co., Charles Trezona being general superintendent. Near this mine in 1875 the first samples of ore were secured that turned the eyes of capital to the State of Minnesota as a source of iron ore. Since Aug. 18, 1884, the mine has produced close to 10,000,000 tons. The Soudan mine was the pioneer of the development of the Vermillion range and still remains the leader, as it is the first of the Vermillion range group of mines to be electrified. Its future available ore is listed at only 600,000 tons, but the operators must have great faith in more ore appearing at depth to spend several hundred thousand dollars to modernize it thoroughly.

The electrification was started in May, 1924, and was not completed until April, 1925. During that time a new steel head frame was erected, new electrically operated hoist and compressor installed, and the mine shaft lined with reinforced concrete and steel. One set of new electric-driven plunger pumps was put in underground, while another electric-driven pumping plant was installed on Lake Vermillion to supply water for the mine and town. Also a new change house, crusher building, and electric haulage system on surface between the shaft and crusher house and stock pile were provided.

As no storage pockets were required, the headframe is only 76 ft. high. It is equipped with two 12-ft. sheaves, and

Kimberly dumps. Three steel idler stands are erected between the shaft and engine house. These, together with head frame, were fabricated and erected by the American Bridge Co.

The electric-driven Allis-Chalmers

The air compressor, built by the Worthington Pump & Machinery Co., is a two-stage machine having a capacity of 2,473 cu.ft. of free air per minute compressed to 100-lb. gage. It is direct connected to a 500-hp. synchronous Westinghouse motor running at 180 r.p.m.

The shaft is sunk on an incline of 77 deg. and its depth from surface to bottom is 1,672 ft. The first 1,472 ft. of lining is made up of reinforced concrete walls with steel dividers, ladders,



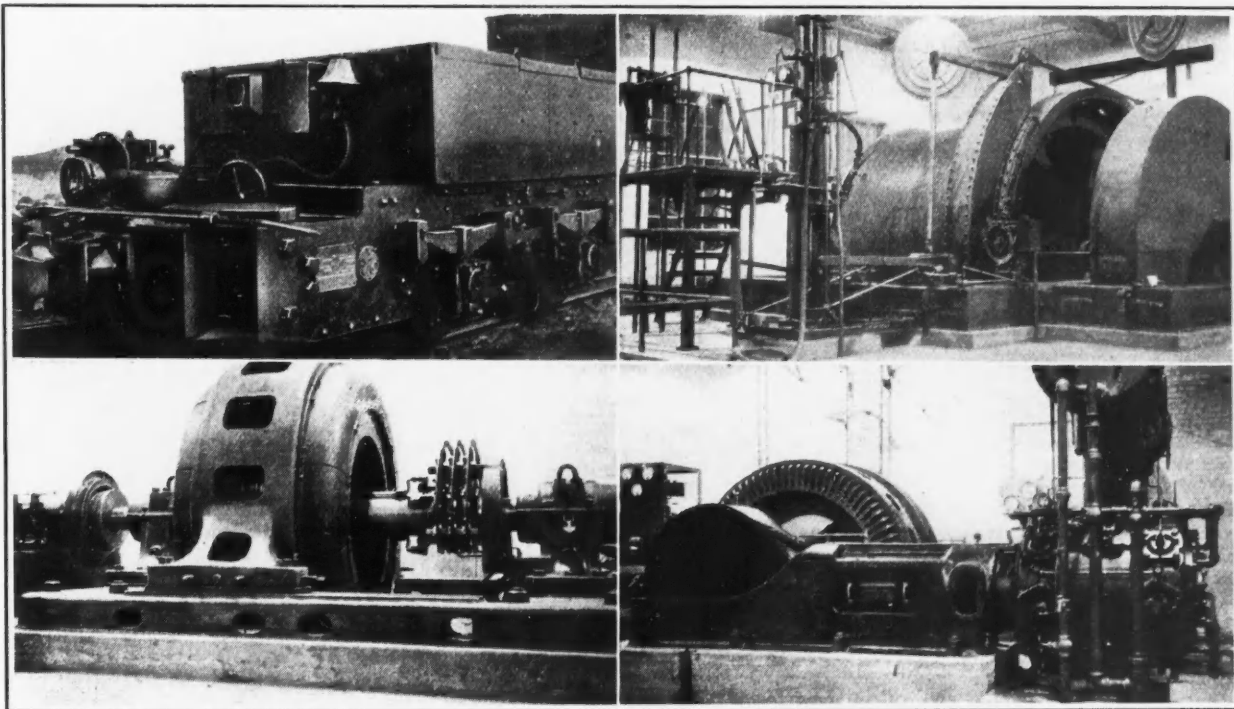
New surface plant at the Oliver Iron Mining Co.'s Soudan mine on the Vermillion range in Minnesota

hoist has one cast-steel drum 12 ft. in diameter by 10 ft. face, designed for a maximum rope pull of approximately 18 tons. This drum will hold 2,600 ft. of 1½-in. cable and runs at a rope speed of 1,000 ft. per minute. One parallel motion post brake holds the load and the hoist is driven through a single-reduction Falk gear by a 600 hp. 2,200-volt three-phase sixty-cycle Westinghouse motor. The hoist runs in balance and each rope is equipped with a single deck cage and a 6-ton skip.

and sollars. The last 200 ft. has no concrete, as the equipment is entirely of steel.

The underground pumps are located on the 850 level and at the bottom of the shaft. At the upper pump house are located two vertical triplex Prescott pumps each of 175 g.p.m. driven by 50 hp. motors. On the bottom are pumps of similar design and make of 75 g.p.m. which elevate the water to the 850 level.

At the Lake Vermillion pump sta-



Above—3-ton storage-battery locomotive for surface haulage
Below—600-hp. 2,200-v. motor for driving main hoist

Above—12-ft. diameter hoisting engine with 10-ft. face
Below—2,500-cu ft. electrically driven compressor

Swedish Steamer Delivers Pebbles at C. & H. Docks

A STEAMER direct from Sweden recently docked at Lake Linden, in the Michigan copper district, with a cargo of flint pebbles for Calumet & Hecla Consolidated. The pebbles are used in the company's regrinding mills in the Calumet and Tamarack reclamation plants. The steamer made the trip through the St. Lawrence River without transferring its cargo. Pebbles of equal hardness and toughness are not available in this country.

tion are located two vertical triplex Prescott pumps of 200-g.p.m. capacity, each driven by 30-hp. Westinghouse motors. These elevate the water from the lake to a filtration plant on top of a hill near by. After the water is treated at the filtration plant, that required at the mine is pumped into elevated tanks, while the water for town use runs from the clear well by gravity and has ample pressure for all purposes except fire, when the pressure is raised with a fire pump.

At the shaft the skips dump into a 6-ton remote-controlled motor-operated tram car, built by the National Iron Works of Duluth, that carries the ore to the crushers. From there a 3-ton General Electric storage battery locomotive carries the ore to the shipping pocket during the summer and the stockpile during the winter.

Three 500-kva. 44,000 to 2,300-volt Westinghouse transformers are located in the substation and power for operating this new equipment is purchased from the Minnesota Power & Light Co. at favorable rates.

All heating mains and electric conduit pipes are installed in concrete trenches underground. In fact the whole installation has an appearance of permanence and an expectation of another forty years or more of operation is indicated.

Tintic Standard Subsidiaries Prospect

The drift on the 780 level of the Eureka Standard mine, at Eureka, Utah, has reached a point more than 825 ft. north of the shaft in the direction of the property of the Tintic Standard Mining Co., which owns control of the Eureka Standard. This heading will be continued to prospect important fissures until a connection is made with the Tintic Standard.

Considerable work is being done in the property of the North Beck Mining Co., also controlled by the Tintic Standard interests. Sinking of the Sacramento shaft has been discontinued at a depth of 720 ft. in order to expedite drifting on the 700 level in a westerly direction through a highly mineralized territory. A number of important fissures should be cut in a short distance. One shift is being employed in drifting from the 600 level of the No. 1 shaft.

Standard Silver-Lead Develops McAllister Mine, Sandon, B. C. Opens Silver-Quartz Ore of Low Grade —Good Surplus, According to Annual Report

The Standard Silver-Lead Mining Co. held its annual general meeting at Spokane recently, when the old officers were re-elected. W. J. C. Wakefield is president. The year 1924 was one of development, rather than of production. By an agreement with the Slocan Silver Mines, the Standard company undertook the development of the McAllister mine, at Sandon, B. C., at depth, in consideration of shares in the Slocan company. A deep-level tunnel was driven and a series of raises were put up to connect with the old workings. On No. 3 level an oreshoot, 3 ft. wide and carrying an average of 30 oz. silver per ton, has been developed for a length of 600 ft.; the same shoot has been developed for a length of 320 ft. on No. 4 level and it has been opened on No. 5 level.

From the top of a raise from the deep tunnel to No. 5 level a drift was run to open the shoot described, and this passed through an entirely new shoot that, as yet, has not been developed above this level. It is estimated that the work described has developed ore carrying more than 1,000,000 oz. of silver, and, though the grade of the ore is low, a specially favorable smelting rate can be obtained at Trail, where siliceous ores are in demand.

The report showed a surplus on Dec. 31, 1924, of \$331,357, of which \$132,250 was in shares in Slocan Silver Mines, which the Standard company now controls, and the balance is in banks and on mortgages.

Consolidated M. & S. Co. Breaks Lead-Production Record

April production of Consolidated Mining & Smelting Co. of Canada was 16,684,394 lb. of lead and 5,232,414 lb. of zinc. Lead production was the largest in the history of the company. The figure for zinc does not represent the mine output, as the reduction works at Trail have not capacity to treat the concentrates produced. A portion goes abroad to Belgium. The company is planning to increase operations. At present it is constructing a new mill of 500 tons capacity at the old Eugene mine, formerly operated by the company and a large producer of silver-lead ores in the past. It is planned to run the old dumps through the new mill together with the ore formerly left in the mine as unprofitable to work under old methods.

French Phosphate Mines Active

The phosphate mines of the French protectorate of Morocco are in excellent condition. Ore reserves are considered far in excess of what they were hitherto believed to be. Native labor is producing 2,000 metric tons per day in the Kourigha district.

In 1921 the annual production was but 8,700 tons, and in 1924, 430,000 tons. French production—from Algeria, Tunisia and Morocco—is estimated at 3,800,000 metric tons.

Trail Ore Shipments

Shipments of ore received by the Consolidated M. & S. Co. at Trail, B. C., during the week ended May 14 were as follows:

Name of Mine	Class	Locality	Tons	Tons
Emerald.....	Lead...	Salmo.....	47	
Elkhorn.....	Lead...	Greenwood..	2	
Prince Henry....	Lead...	Greenwood..	21	
Providence.....	Lead...	Greenwood..	3	
Silversmith.....	Lead...	Sandon.....	76	
				149
I.X.L.....	Dry....	Rosland....	34	
Knob Hill.....	Dry....	Republic....	111	
Quilp.....	Dry....	Republic....	113	
Yankee Group...	Dry....	Grand Forks	4	
				262
Mountain Chief..	Zinc....	New Denver	31	
Silversmith.....	Zinc....	Sandon.....	51	
				82
Company mines.....				5,955
Total.....				6,448

Elkoro Mines Netted \$60,644 During First Quarter

Gross production of the Elkoro Mines Co., at Jarbidge, in Elko County, Nev., for the first quarter of 1925 was \$134,306.55 from the treatment of 13,568 tons of ore having an average value of \$9.886 per ton, according to the company's bullion tax statement to the county assessor.

Deductions included charges for mining, \$38,762.77; development, \$8,772.08; reduction and sales, \$26,127.34; a total of \$73,662.19, leaving net proceeds of \$60,644.36, on which the company paid \$1,014.64 bullion tax. Net proceeds for the last quarter of 1924 were \$53,655.

Shattuck-Arizona Successfully Floats Lead Carbonate Minerals

An experiment, proving that lead carbonate ore can be concentrated by the use of the flotation process exclusively and without tabling, has been successfully concluded by the Shattuck-Arizona Mining Co. The carbonate minerals are sulphidized before flotation.

Under the new process worked out at the Denn concentrator, all ore is sent directly from the ball mills and classifiers to the flotation plant, thus eliminating the use of all tables.

The installation of the new process was done with but little change or the purchase of additional equipment and has resulted in a tremendous saving in the short time it has been in use, it was announced. The mill is not operating at full capacity, running through only about 150 tons daily.

Lightning Kills Miner Repairing Steam Pump Underground

An unusual mine accident occurred in the Joplin-Miami district on May 20, when William Frye, 22 years old, was killed by lightning while working in a shaft of the Lucky Joe mine, northwest of Joplin, Mo. Frye was working with Howard Frizzell, and neither man knew a storm was in progress above ground. Frye was holding a steam line out of his way while he dug at a pump seat, when suddenly there was what Frizzell described as an explosion. "My God, Deacon, I'm killed!" cried Frye. He was dead a moment later. Frizzell, who wore rubber boots, was shocked but not seriously injured.

**A. S. & R. Paints Dark Picture
in Carson Patent Appeal**

Sees "Suspension of Mines and Demoralization of Copper Prices"

The American Smelting & Refining Co. has asked the U. S. Supreme Court to review a decision of the Ninth Circuit Court of Appeals in a case against George Campbell Carson involving patents on side feeding of reverberatory copper furnaces. The smelting company lost in the lower court. The case was virtually a test, and the decision will affect all smelters. The effect of the decision of the lower court is to enjoin the smelters of the A. S. & R. Co., representing one-fourth of the copper production of the country, from smelting copper ores in accordance with the mode of operation provided in certain patents taken out years ago by Carson.

"Practically every reverberatory copper furnace in the United States may have to be reorganized and rebuilt to avoid future infringement," says the A. S. & R. Co. "They must be constructed and operated so as to introduce the material to be smelted in a way different from that which has been the standard practice since 1915. The entire copper-smelting industry is to be made to respond in damages for past infringement. To force a basic industry to effect changes in construction and mode of operation of such magnitude and character within a limited time would entail grave and far-reaching consequences. The direct loss and injury to copper companies would be great. It would force suspension of mines and interfere with the production of copper and demoralize copper prices."

**Owens Lake Leaching Plant
Ready to Run**

The Continental Development & Reduction Corporation, headed by T. R. Lombard of Pasadena and J. S. Tremayne of Los Angeles, has practically completed the work of converting into an ore-leaching plant the potash works of the Chemical Refining Co., on Owens Lake, two miles south of Keeler, Calif. Since the acquisition of the plant about three months ago, the new company has installed crushers, ball mills, classifiers, vats, and other machinery required for the reduction of ores by the leaching process. John D. Fields is the company's metallurgist.

Operation of the remodeled plant will begin on lead-copper-silver-zinc ores from the properties of the Acme Mining Co., a subsidiary, at Darwin, 25 miles east of Keeler. Ore bins have been erected at the Bunco Billy "glory hole," at the top of a three-quarter mile grade near that property, and at the leaching plant. Three tractors, already delivered to the company, will haul ores from the various properties to the top of the grade, whence they will be transported by motor trucks to the plant for reduction. While the company has provided the plant primarily for the treatment of the ores of its subsidiary concerns, it will accept custom ores. This has stimulated mining activity throughout the Owens Lake dis-

trict. White lead, silver bullion, copper, and zinc oxide are to be produced, according to plans.

The Calivada Mining Co., operating the Pete Smith lead-silver mine, five miles southeast of Keeler, is preparing to take advantage of the local means of ore reduction provided by the Continental plant, four miles distant. Heretofore the Calivada has sent its product to the Midvale, Utah, plant of the U. S. Smelting, Refining & Mining Co., the latest shipment of 20 tons bringing production thus far this year up to a total of 220 tons of an average value of \$45 a ton in silver and lead.

**British Columbian Mining
Dividends**

Dividends declared by mining companies in British Columbia during the year 1924 compared with 1923 are as follows:

Name of Company	1923	1924
Premier Gold Mining Co., Ltd.	\$1,738,000	\$1,715,000
Consolidated M. & S. Co. of Canada, Ltd.	632,022	641,043
Howe Sound Copper Co.*	198,415	198,415
Silversmith Mines, Ltd.	150,000	175,000
Wallace Mountain Mines, Ltd.	5,400	59,400
L.X.L. (Trail Creek division)	22,958	56,000
Bell (Greenwood division)	.....	48,000
Apex (Slocan division)	.....	1,834
Mountain Chief Mines (Slocan division)	.....	1,482
Belmont-Surf Inlet Mines	62,500	.....
	\$2,809,295	\$2,896,174

*The Howe Sound Copper Co. is the holding company for the Britannia mine in British Columbia, and the El Potosi mine in Mexico. Dividends paid by this company are therefore derived from the profits on operation of both mines, so that only part of the dividends paid, as shown, can be credited to the Britannia mine.

The amount of \$2,896,174 shown above as distributed in 1924 by no means represents the total of net profit earned during that year. In nearly all cases substantial sums are set aside from profits to the credit of surplus and reserve accounts. Profits accruing through private companies and individual mining enterprises as a rule are not given publicity as dividends, as is the case with the large companies, so that no record of these profits, which in the aggregate are considerable, is available.

The Granby Consolidated Copper Co., a big producer, paid no dividends.

**English Lead Mines
to Be Reopened**

A group of abandoned lead mines in Derbyshire, England, will be unwatered and reopened by a company now being formed for the purpose, according to a report from London.

There are about 100 abandoned lead mines in the district, which is known as the Matlock Valley region, the workings extending under the main Manchester-London railway line. The British are heavy consumers of lead. In 1923 Great Britain consumed 34.42 per cent as much lead as the United States, though only 14.32 per cent as much copper.

**Gold Queen Camp, Mineral
County, Nev., Yields Bonanza**

California Capitalists Finance Development—Mill \$150 Ore From Golden Gate Lease

Joseph McMillan, formerly general manager of the Pacific Electric Co., and associates have secured an option to purchase the Silver Trail group of claims adjoining on the west the Golden Gate group, the discovery property, in the new Gold Queen district, in Mineral County, Nev., and have become identified with the Silver Canyon Mining Co., which owns six claims located 1,500 ft. west of the bonanza find. Conditions present on both the Silver Trail and Silver Canyon estates indicate that they may be traversed by the Golden Gate "picture rock" vein. Prospecting will start soon on both properties.

Al Stevens and J. F. Van Every and Mrs. Pearl Smith, the leasers on the Golden Gate property who made the rich discovery, have begun hauling ore from their find to their recently completed 12-ton Huntington mill, three miles distant. More than 50 tons of ore ranging from \$150 to several thousands of dollars to the ton in value has already been extracted from the discovery. With an enlarged working force this tonnage is being steadily increased and the leasers are certain that they can keep the mill running continuously until the expiration of their lease in August, after which the owners of the property will operate it.

Ben Leet, E. H. Johnson and Charles Leicham, of Bishop, Calif., have put a force of miners to work on their Pine Top group of nine claims adjoining the Golden Gate property on the north. Several veins have already been exposed that give encouraging values in gold and silver. The Sierra Talc Co., has joined W. M. Rae of Golden Queen in the ownership of a diatomaceous earth deposit, located a half mile south of the Golden Gate property, and started its development.

**Smaller Interests in Joplin-Miami
District Consolidate**

Some investors at Jefferson City, Missouri, who have had interests in the Joplin-Miami field for some years, recently amalgamated their interests into one company, known as the Cortez-King Brand Mines Co. W. L. Landrum, of Picher, Okla., is manager.

Mines included in the amalgamation are the Cortez, King Brand, New York, Bull Frog, and Liza Jane. The same people that own these properties own a half interest in the Jeff City mine, but the other half is owned by officials of the Eagle-Picher Lead Co., so it is not included in the new concern.

It is becoming popular in this field to combine several enterprises into one company. It is believed that by so doing much overhead can be cut down, and there is an added advantage when it comes to selling ore.

The leading producers are the Federal M. & S. Co., the Eagle-Picher Lead Co., Commerce M. & S. Co., Golden Rod M. & S. Co., and St. Louis S. & R. Co., all strong interests.

Exploration in Michigan Copper Country Indicates Optimism

Franklin, Arcadian Consolidated, Mayflower-Old Colony, and
Calumet & Hecla Active

By M. W. Youngs
Special Correspondent

EXPLORATORY WORK in the Michigan copper district generally is interpreted there as an evidence of faith in the Lake mines. The several companies, in searching for new deposits, are building for the future, preparing for the time when such deposits will be needed. It requires years to open and develop them and the policy pursued is construed as one that reflects the permanency of the district.

Franklin's exploratory shaft in the Kearsarge lode is down 260 ft. A crosscut east to test the formation, started at a depth of 250 ft., is in 20 ft. and will be continued approximately 100 ft. farther to the Wolverine sandstone. Meanwhile sinking has been suspended. A vein believed to be a branch of the Kearsarge has been cut and it is expected other lodes will be tapped. The objective should be reached in two weeks, when sinking will be resumed. The shaft is going down into the vein and is being sunk as a working shaft so that construction of this sort will not be necessary if profitable copper deposits are found. There has been copper in the lode all the way and although not commercial, the showing is encouraging.

At Arcadian Consolidated, drifting has been temporarily stopped in the 1,850-ft. level and a crosscut started west to cut the old Arcadian lode. The opening is in 50 ft. and has 150 ft. more to go. The objective should be reached in a month. The vein will be opened sufficiently to test its value, and drifting then will be resumed in the 1,850. Fairly good ground continues to be opened in the 1,250-ft. level drift toward the New Baltic shaft. The showing in the 1,850 has not been so good of late, there being more indifferent ground than in the 1,250.

Childress Rebuilds

Commonwealth Concentrators

Frank Childress, of Joplin, Mo., has brought a half interest in the mines of the Commonwealth Mining Co., in the Joplin-Miami field, and will be in general charge of operations. Direct management has been turned over to Earl Childress, his brother, formerly superintendent of the Childress Lead & Zinc Co.'s Wade mine. The new management already has provided for the reconstruction of the two concentrating plants of the company, and the work is under way. A new shaft also is being sunk at the No. 2 mill.

Mercury Ores Found in Arizona

What appears to be an important discovery of cinnabar has been made by Wes Goswick and William Packard, thirty miles north of Roosevelt Dam, on Slate creek, in the Mazatzal range of mountains, in Gila County, Arizona.

Calumet & Hecla Consolidated's exploratory project in LaSalle lands is well under way. Crosscutting has been proceeding for two months at a depth of 300 ft. from an old shaft reopened for the purpose. It is a shaft sunk many years ago in the Osceola lode by the Tecumseh company. The crosscut has cut through one amygdaloid vein, but nothing unusual has yet been developed. The crosscut is about 300 ft. in length and will be driven to the Allouez conglomerate lode. When completed it will be 2,500 ft. long and will have gone through a territory in which but little exploratory work has been done, cutting the Calumet conglomerate and several amygdaloid veins.

At Cliff, another Calumet & Hecla exploration, an old shaft, reopened, has been sunk to a depth of 150 ft. and crosscutting is about to start. When the shaft or pit was reopened it was found to be down into the rock only 65 ft. and it was necessary to sink it to its present depth. The crosscut, which will be driven several hundred feet, will cut the Osceola amygdaloid, Calumet conglomerate and Cliff fissure vein. It will penetrate virtually the only area in the Cliff lands not heretofore thoroughly investigated. Interest particularly attaches to the tapping of the fissure vein in which Cliff formerly obtained its rich values.

Mayflower-Old Colony's crosscut proceeding west toward the St. Louis amygdaloid is well beyond the Mayflower fault, but still has a considerable distance to go. It is traversing an area in which the pitch and strike of the beds conform to the usual and where there is little likelihood of disturbed conditions of the formation as a consequence of faulting in the immediate locality.

The vein crops at intervals through slate and has been located for a distance of three miles. Ore assaying up to 23 per cent mercury has been uncovered by surface workings. A fair tonnage of 3 per cent ore is exposed. This is the third discovery of cinnabar in this vicinity.

Lay Steel on C. & H. Road

Work of laying steel on Calumet & Hecla Consolidated's 9-mile railroad between the Ahmeek mine and stamp mill, in the Michigan copper district, has been started and completion of the project by Aug. 1 is expected. Grading has not yet been completed, two large fills remaining near the Torch Lake terminal. The railroad, which will substantially cut hauling costs and provide a more direct route and easier grade, will serve Ahmeek and other Kearsarge lode mines of the company. Sufficient rolling stock is on hand to equip the new road.

St. Joseph Lead Co. Employees Have \$10,000,000 Group Insurance

By expanding its group insurance program, the St. Joseph Lead Co., operating in southeast Missouri, has enabled 2,200 of its own employees and those of affiliated companies to increase their protection by \$2,200,000 bringing the total in force to approximately \$10,000,000. Altogether, more than 4,000 employees of the St. Joseph Lead and affiliated companies, including those of the old Federal Lead Co., are insured under these group plans.

The first group contract was taken out more than five years ago, and during the period elapsed since then, the insurance company has paid in claims more than \$200,000. Under the original plan, employees with at least six months' service to their credit were given protection, without cost to them, ranging for an individual from \$500 to \$2,000. Subsequently the plan was made co-operative, with employer and employees jointly paying the premiums. This plan makes available to each contributing employee \$1,000 insurance over and above the amount to which he was entitled under the original contract.

Georgia Manganese Production

Specialists of the U. S. Geological Survey have just completed estimates showing the shipments of manganese and manganiferous ores from the Cartersville district, in Georgia, during the eight years 1917-1924. These estimates show that the shipments amount to 11,100 gross tons of ore containing 35 per cent or more of manganese, 66,000 gross tons of ore containing 10 to 35 per cent, and 31,000 gross tons of ore containing 5 to 10 per cent.

Lode Platinum Discoveries Reported in British Columbia

Charles F. Law, who some years ago recovered a considerable amount of platinum from the placer gravels of the Tulameen River, in the Similkameen mining division of British Columbia, after reading of the South African discoveries, went to the site of his former operations, at the point where Eagle Creek flows into the Tulameen River, and there he found pockets of chromite in a serpentine formation, and on crushing and panning the chromite he found that it contained platinum. The discovery has caused considerable excitement, and about 100 claims have been staked in the vicinity.

The discovery of lode platinum in British Columbia is not new, and it is rather remarkable that no effort has been made to explore for this metal. In 1918, the late William Thomlinson, acting for the Munitions Resources Commission, sampled a number of likely locations and assays were made at the Dominion Government laboratories. The most promising location was found at the Franklin camp, in the Grand Forks mining division, where in a belt of pyroxenite-syenite platinum up to 0.38 oz. per ton was found associated with chalcopyrite, which occurred in veinlets and pockets in several deposits.

London Letter

By W. A. Doman
Special Correspondent

Rand Gold Shares Less Attractive in London

Disappearance of Gold Premium Affects Profits—Platinum Speculation— Note of Warning

London, May 12—The gold "premium" having disappeared, interest in gold shares is not so keen as formerly, and where the South African market is concerned it is mainly in platinum issues. Not that the public is "in" to any great extent. It is largely a gamble on the part of big people, who are certainly raking in the shekels.

Perhaps it would be incorrect to say that the movement has reached its apex. When speculation is rife, it spreads. But in more than one quarter, and curiously enough from South Africa itself, a note of warning is being sounded. Hundreds of thousands of pounds have been added to the value of the capital of various companies on reported low-platinum assays. Even should these prove correct, and the finds be extensive enough to make a profitable proposition, much time must elapse before the metal can be won. And this is what is being pointed out.

Stephen Lett, an engineer who is on the spot and who has examined all the published reports on the "platinum Rand," cannot find sufficient justification for present prices. He, as well as others, mentions the metallurgical difficulties to be overcome. Dealers in scrip ignore the warnings, and companies owning land anywhere in the vicinity have given options to other companies to prospect for platinum. Walter McDermott, chairman of the Consolidated Mines Selection, stated that his company had examined certain properties, and some options had been secured, though others were abandoned, and he was very guarded in his remarks. The Central Mining & Investment Corporation report naturally mentions platinum, because the company is interested in the Transvaal Consolidated Lands, which owns promising areas, though here again the reference is, in the main, non-committal.

The course taken by Burma Corporation shares has confounded the bears, and their predicted price of 8s. 6d. seems further off than ever. Latest news is to the effect that satisfactory progress has been made with the erection of a new line of barricades inside the sealed area preliminary to the recovery of winze 1135 South, beyond which there is no change to report. Work at the mine and treatment plant is proceeding in the same way as during the past two months. In addition it is stated that the probable position for the present financial year ending June 30 indicates that the surplus over working expenditure will exceed the figures for the previous year, notwithstanding the effect of the fire, and after charging out all expenses in connection therewith. The price has risen to 14s. 9d.

H. F. Marriott's work on "Money and

Mines" is likely, according to the preliminary statement, to cause something of a sensation. He is said to criticize pretty severely the administration of certain Witwatersrand mines, and in fact to show that they could be worked to better advantage. Mr. Marriott knows his subject thoroughly, as he held the position of consulting engineer to the Central Mining & Investment Corporation for several years. He is a stickler for straightforward dealing, arguing that the money is subscribed by the public, which should be given all information and get the best possible return on its capital.

Commerce M. & R. Co. Builds Central Power Plant

Three Compressors and Five Miles of 10-in. Distributing Pipe—Owns Twelve Concentrators

The Commerce Mining & Royalty Co. is building one of the most complete central power plants in the Joplin-Miami district, near Cardin, Okla. The building itself is 40 by 90 ft., of hollow tile construction with galvanized roof. Equipment will include three compressors, each of 2,500-cu.ft. capacity, to be operated by direct-connected electric motors. The main leads from the plant to the company's various mines which are to be served by the power plant will be of 10-in. pipe. It will take more than five miles of pipe to reach the various properties.

The Commerce has long been one of the important companies in the Joplin-Miami field. It has 10,000 acres of land which it either owns outright or has under lease, and has twelve concentrating plants in operable condition. At present five are not running because of the unattractive price of zinc ore.

Only a portion of the company's big acreage has been developed, but it has a number of mill sites drilled out that promise to be as rich as any properties the field has known. J. F. Robinson, of Miami, Okla., is president of the company.

Burma Mines April Production

During the month of April Burma Mines, Ltd., mined, at Bawdwin, 26,090 tons of ore, including 2,865 tons of high-grade ore. Of this, 18,850 tons was milled, producing 7,227 tons of lead concentrate; 8,823 tons of lead-bearing material, including 1,666 tons of high-grade ore, was smelted in the blast furnaces, producing 3,448 tons hard lead for treatment in the refinery. Refinery products were 3,502 tons refined lead and 370,000 oz. refined silver. Of the silver production, 48,428 oz. was recovered from the treatment of copper matte. The experimental zinc plant produced 1,150 tons zinc concentrate, assaying 16.9 oz. silver, 8.5 per cent lead and 42.75 per cent zinc.

In addition to the above, 700 tons copper matte was produced from the treatment of accumulated smelter by-products and 4,151 tons copper ore; and 150 tons of antimonial lead was produced. The tonnage of lead-bearing material smelted also includes 830 tons of old Chinese slag recovered from Sterne River.

Washington News

By Paul Wooton
Special Correspondent

Domestic Graphite Producers Study Possible Tariff Increase

Increased Competition From Madagascar— Situation Complicated by Conflict of Interests

Increases in the rates of duty applicable to graphite are being contemplated by the domestic producers of that commodity. This action is promoted largely by increased competition from Madagascar. The industry in that island is again reaching large proportions after the depression that followed the war and the continuation of export restrictions. In addition, the pressure of competition is increasing from Korea and from British India.

The classification of graphite for tariff purposes is peculiar in that the three classifications—amorphous, crystalline and crystalline flake—are difficult of differentiation under certain conditions. The fear is expressed that customs appraisers depend on the locality of origin to determine the classification. This is not accurate procedure, it is pointed out, as it is known that production is not always confined to one type. All three kinds of graphite, for instance, come from a mine in Canada.

Before the war makers of crucibles contended that American graphites could not be substituted successfully for the Indian product. Under the exigencies of war conditions the crucible producers devised means whereby the American product was used with success. Experiments at the Ceramic Station of the Bureau of Mines and at the Bureau of Standards are interpreted by the domestic producers as proving conclusively that the American graphites and bonding clays can be used just as successfully as the imported articles. The crucible makers are said to retain a prejudice against the American products which insures importers a market in this country. Because of the very low cost of production in Madagascar, India, Korea, and Mexico, the feeling is that higher rates can be justified.

The crucible makers, in addition to their continued belief in the superiority of the imported material, complain of the instability of American sources of supply and lack of uniformity in the graphite furnished. At no time have the domestic producers supplied more than one-third of the country's graphite requirements, and at the present time they are furnishing less than one-fourth of those requirements, it is contended.

The large production of artificial graphite is another factor that is complicating the situation. Another factor that has an important bearing on the tariff rates is the fact that the Mexican production, most of which is shipped by rail to Saginaw, Mich., for manufacture, is the product of American enterprise and constitutes the raw material for other American enterprises, some of which have built up large export trade. American capital also is a large factor in the Korean production.

Mexico City Letter

By W. L. Vail
Special Correspondent

Government Will Seek Solution to Guanajuato R. & M. Co. Trouble

Company Will Operate Pending Investigation by Commission—Boleo Difficulties Also Composed

Mexico City, May 12—The Guanajuato Reduction & Mines Co. has accepted the offer of the federal government to appoint a commission in an effort to bring about a solution of the difficulties between the company and the state authorities. Following the issuance of official notice by the company that it would close all its workings on May 18, the state authorities imposed a fine of 300,000 pesos, to be paid workmen in the event that operations were suspended. Pending the work of the commission, it is understood, the company will continue operations as usual. While the alleged reason for a shut-down was given that the low grade of the ores made mining unprofitable, the real reason is believed to have been inability to work under the recent drastic laws passed by the local legislature.

The Secretary of Commerce and Industry, acting as intermediary, has brought the striking miners at El Boleo, in Lower California, to agreement. Many of the workmen have gone back, according to reports. Some concessions were made by the company and some by the men. The strike had lasted over a month and famine was setting in, as the only source of food supplies was from the company's stores. All means of transportation to the port also are controlled by the company.

The Moctezuma Copper Co., operating in Sonora, owing to the continued low price of copper has decided to suspend operations one day each week.

Reports from El Oro, state of Mexico, state that the Dos Estrellas is turning out about 18,000 tons monthly at a profit of about 15,000 pesos monthly and that El Oro Mining & Railway Co. is milling about 13,000 tons monthly, with a reduced profit of 10,000 pesos. Both companies have done considerable exploration work during the past six months.

From Zacatecas comes the information that the Pittsburgh-Veta Grande is increasing its plant to handle the siliceous ores of the district, and that the Peñoles company is to purchase the siliceous ores. Production from Fresnillo camp continues at the rate of about 4,000 tons of ore daily.

Several thousand mining claims have recently been declared void by the mining department, because of failure of the owners to pay taxes. In an interview the head of the department states that these claims are being tabulated, with a complete record of work done (in most cases), and that foreign capital will be invited to re-denounce the best of them and proceed to work them. The mining officials desire to give every facility to bona fide operators, but are discouraging the taking up of claims for speculation.

According to official statements, a liberal portion of the \$15,000,000 being raised by the government by a special tax on gasoline for the purpose of making good roads will be appropriated for the development of some of the now isolated mining sections of the country. Plans have already been submitted to the department and early construction work is promised.

United Verde Employees Benefit by \$100,000 Bequest of Senator Clark

The \$100,000 left to the city of Clarkdale, Ariz., in the will of the late Senator William A. Clark of Montana, president of the United Verde Copper Co., will be used to construct a recreational center for the employees of the company, it has been tentatively announced by Charles W. Clark, one of the executors of the estate and now president of the copper company. The recreational center would include a swimming pool, dancing pavilion, and clubrooms, it was stated. Definite plans for the memorial will be announced later.

Crestline Developments Continue Favorable

Prospects for the Crestline section of the Joplin-Miami district continue to improve. An exceptionally good drill strike was made recently by F. W. Evans on the Roanoke lease, consisting of 160 acres located near the Chestnut lease. Other drill holes will be put down and if the orebody is proved, a mill will be erected immediately.

The Eagle-Picher Lead Co. has virtually completed the Ellis mill, in this section, which is a plant replacing one burned several months ago. On the lease adjoining this property the mine of the Crestline Products Co., owned by O. W. Sparks and associates, of Galena, Kan., has developed into an excellent producer and has helped the entire Crestline field materially.

New Jersey Mining Exchange Opened in Jersey City

The New Jersey Mining Exchange, including a number of brokers who formerly operated on the New York Curb, opened its doors at 1 Montgomery St., Jersey City, recently.

Former Governor William S. Sulzer of New York and U. S. Senator Edward I. Edwards of New Jersey made speeches at the opening. The exchange can be reached in a few minutes from downtown New York, as it is situated near the station of the Hudson Tubes. It is claimed that New Jersey laws are less burdensome than those of New York State and the hope is to take advantage of this and at the same time do business for New York as well as New Jersey customers. The provisions of the revamped Martin law, compelling vendors of shares in New York to publish facts regarding the organization behind the shares, is expected to have an influence on the career of the exchange. This law becomes effective June 1.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Premier Paymaster Manager Recommends Building Mill

Funds to Come From Assessments—\$837,617 Spent to Date on Development

Toronto, May 23—Stockholders of the Premier Paymaster Mines Co. of Porcupine have received a report in which the manager recommends to the directors the building of a 300-ton mill. Accompanying the report is a notice of two assessments, each for 10c. a share, payable June 1 and Oct. 1. The money raised by the assessments will be used to finance the construction of the mill, for additional plant and for increased underground development. It is proposed to install crushing capacity for a mill of 300 tons a day capacity, but the initial unit for fine grinding and cyaniding will have a capacity of 100 tons a day. The new construction is estimated to cost \$175,000. The financial statement shows total expenditures to April 30, of \$837,617, while cash on hand is \$57,055.

The Lake Shore Mines of Kirkland Lake has declared the regular quarterly dividend of 5 per cent, with an extra bonus of 5 per cent, payable June 15, to shareholders of record June 1. Developments at the property continue to be satisfactory and a very considerable amount of ore has been proved on the 1,000 level.

Tough-Oakes officials state that conditions at this property have improved and it is hoped that during the month of June the company will be able to make a profit. It is understood that up to this time operations have resulted in a small monthly loss, but better ore is being found between the 800 and 1,000 levels, which will help to raise the grade. It has also been decided to stop milling ore from the dump and to take all or from underground.

The new shaft of the Kirkland Lake Gold is now down to the 1,850 level and will be continued to 2,000 ft., at which point lateral development work will be started. A diamond-drill hole was put down from the 1,600 to the 2,000 levels and indicated values very similar to those found in the upper levels. The favorable feature, however, was the much greater width of porphyry found at the lower depth, and it seems to be essential for the occurrence of large orebodies that they should be found in the vicinity of masses of porphyry.

Recent developments on the Mining Corporation property in South Lorrain indicate that the oreshoot found a few months ago is the largest that has been discovered to date in this camp. This oreshoot has been opened up for a length of 100 ft. on the 225 level and has now been cut at the 150 level, where a drift of 23 ft. shows a width of 8 to 12 in. of ore averaging approximately 5,000 oz. to the ton. It is believed that this shoot alone will produce more than 3,000,000 oz. of silver and should enable the company to go on a dividend basis in the comparatively near future.

Men You Should Know About

William Russell, London manager for the Dorr Company, is in New York on a short business trip.

J. P. Bickell, president of the McIntyre-Porcupine Mines, is making an inspection of the property.

Walter Douglas, president of Phelps Dodge Corporation, is making an inspection of the company's properties in Arizona.

Norman C. Stines, manager of the U. S. Smelting company's operations in Alaska, was recently in San Francisco completing final arrangements for the continued operations of the Nome properties previously worked by the Hammon interests and recently acquired by



Norman C. Stines

the U. S. Smelting. Mr. Stines is also in charge of operations at Fairbanks, where the U. S. Smelting is interested jointly with W. P. Hammon and his associates in developing placer properties. Mr. Stines will leave for Alaska early in the summer.

J. Treichler, who was on the staff of the Mammoth Copper Co. at Kennett, Calif., has been transferred to Nome, Alaska.

George A. Packard, mining engineer, has returned to Boston from a trip on professional business to Colombia, South America.

R. E. Phelan, of the Metals Exploration Co., of San Francisco, has returned from a mine examination trip in Sonora, Mexico.

Ira B. Joralemon, mining engineer of San Francisco, has returned to San Francisco from a professional trip to the Ahumada mine.

L. C. Lundquist, mining engineer for the San Rafael y Anexas Co., Pachuca, is now in California recuperating, after a serious illness from pneumonia.

Matthew Van Sieten, mining engineer with the U. S. Bureau of Mines, was recently in San Francisco visiting the Berkeley station of the Bureau.

E. B. Braden has resigned as general manager of the American Smelting & Refining Co., but will remain with the company in an advisory capacity.

Dr. Walter Harvey Weed is at present at Canon, Ariz., where he is engaged in making an examination of the property of the Kay Copper Corporation.

Philip R. Bradley, consulting engineer for the Alaska Juneau Gold Mining Co., recently left San Francisco en route to Kellogg, Idaho, and Juneau, Alaska.

H. T. Hamilton, mining engineer of San Francisco, recently returned to San Francisco from Hamilton, Nev., where he is interested in reopening a mining property.

Louis D. Huntoon, consulting engineer of Everett Mines, Ltd., has gone to make an investigation of the company's property in the Gowganda silver area of northern Ontario.

Herman Dauth, a mining engineer of Los Angeles, has returned to Los Angeles from an extended visit in and around Tonopah, Nev., for the West End Consolidated Mining Co.

J. B. Harper has been appointed superintendent of the Carson Hill Gold Mines, Inc., R. C. Eisenhauer having resigned from that position, which he held for some time, to undertake professional work.

Ludwig Vogelstein, chairman of the board of the American Metal Co., Ltd., sailed last week for an extended trip through Europe. Mr. Vogelstein is expected to remain abroad until the end of the summer.

A. D. Miles, Canadian representative of John Taylor & Son, of London, has just returned from a conference in England with the officials of Anglo-Canadian Explorers, Ltd., with regard to operations on their properties.

Leonard S. Austin, who is just putting the finishing touches to the sixth edition of his "Metallurgy of the Common Metals," recently visited the Magma plant at Superior, Ariz., and the New Cornelia plant, at Ajo.

H. C. Smith has been appointed resident manager for the Granby Consolidated Copper Co. at the company's property at Allenby, B. C., according to the announcement of **Charles Bocking**, who has returned to his headquarters at Anyox.

Charles A. Mitke has a scouting organization in the field investigating properties for Eastern clients. Present attention is being devoted to Arizona, but the possibilities are that the work may be extended to other states later.

W. R. Bolley, formerly superintendent of the Wolverine branch of the Mohawk Mining Co., in the Michigan copper district, has been appointed general mine superintendent of all the Mohawk properties. Mr. Bolley is a graduate of the Michigan College of Mines.

Chester Gibbs, formerly mining engineer at the Seneca mine, in the Michigan copper district, has been appointed superintendent at the Arcadian mine, where he will have charge of development operations. Mr. Gibbs, a graduate

of the Michigan College of Mines, has been in the employ of the Arcadian for some months as an engineer.

Obituary

John Doyle, manager of Pato Mines (Colombia), Ltd., died at the mines near Zaragoza, Colombia, on April 13 of heart failure. For several years he had been a sufferer from an erratic heart. Mr. Doyle went to Pato Mines in 1914 as dredgemaster. In 1916 he was advanced to the position of superintendent, which he held up to the death of the manager, Mr. Prichard, in 1923. He was then given the management of this important enterprise. Prior to going to Pato the deceased had dredged in California, Nevada, and the Yukon,



John Doyle

and was considered an expert in that line of work. At Pato he proved his ability quickly by successfully dredging the beds of auriferous clay-gravels which had baffled his predecessors. In the interim the Nechi Mines (Colombia), Ltd., was organized by practically the same personnel as the Pato company, and began dredging on the opposite side of the river from Pato. Doyle was given charge of that work, and handled both operations with marked success. During the late war, when it was next to impossible to ship in dredge spares and dredge men were difficult to get, Doyle acted as dredgemaster on both Pato and Nechi dredges, carried on the superintendency, spliced old cables together for side lines, patched wornout tumblers and other dredge parts, and used many other makeshifts until materials and labor were again available. The Nechi property was worked out by Doyle, and with Pato paid large dividends during his régime.

William Mitchill Norris, of Princeton, N. J., mining engineer and geologist, died on May 23, at Maracaibo, Venezuela. For the last ten years he had been prospecting for oil and minerals in Central and South America for the British Controlled Oil Fields, Ltd., of London. Mr. Norris was thirty-six years old. He was graduated from Princeton in 1910 and afterward continued his studies at Columbia.



Mineral producers of California at recent statewide conference at Los Angeles

Societies, Addresses, and Reports

California Mineral Conference at Los Angeles

Need for State Department of Mines and Mining Pointed Out—
Rush T. Sill Presides

AT LOS ANGELES, CALIF., on May 15 and 16, a conference upon the difficulties of mineral producers of California was held under the auspices of the California Development Association. More than 200 producers and company executives met in the rooms of the Los Angeles Chamber of Commerce. Metal and non-metallic mineral producers made up the bulk of the attendance. The purpose of the conference was to bring mineral producers together that they might definitely state how existing conditions could be improved. Rush T. Sill presided at the meeting.

R. W. Pridham made a formal address of welcome on behalf of the Los Angeles Chamber of Commerce. The first speaker, E. B. Criddle, of the Southern Sierras Power Co., gave an interesting address upon the relation of the electric power companies to the mining industries. Frank D. Scott, of the Southern Pacific Co., in discussing transportation and the mineral industries, stated that the railroad gave service, rates and facilities. Rates must be sufficient to give a reasonable return on investment in transportation facilities. Industrial rates are considered in relation to competitive factors and industry as a whole. Industrial development is essential to California and industry must come from the ground and the development of mining means a greater rate in building up the back country. The railroad companies are hand in hand with mining activities, "and," said Mr. Scott, "your business is our business—sound, steady development makes for individual prosperity."

The status of the cement industry was detailed at length by G. A. Beckett, of the Riverside Portland Cement Co. Briefly, this industry is operating at two-thirds capacity by reason of the importation of Belgian cement into the Pacific Coast region. Almost 50 per

cent of foreign cement importation is concentrated upon the Pacific Coast to the detriment of the domestic producers. These importations, amounting to 750,000 bbl. in the coast region during 1924, represent about \$2,000,000 remitted abroad and a corresponding loss to local producers. The abnormal exchange situation and ballast freight rates are the primary factors bringing about this situation. The situation affects oil producers, railroads, power companies, sack makers, and gypsum producers as well as labor. The investment in cement manufacture in southern California is about \$22,000,000. The five active mills employ from 1,500 to 1,800 workers.

Robert Linton, representing the Pacific Clay Products Co., discussed the clay products industry of California and stated that the requirements of the state could be supplied from its own deposits. California produced in 1923 more than \$20,000,000 worth of clay products. Foreign importation is not a factor in the industry. The areas of clay production are comparatively restricted, but new areas will be discovered as the old ones become exhausted. High costs, due to transportation, are an important factor in delivering raw clay to the plants. Mr. Linton advocated the making of an accurate survey of the kinds and quantities of clay products being shipped into the state from outside sources and stated that there was a real need for geological, structural, and economic studies of the clay deposits.

May Y. Seaton discussed the non-metallic mineral situation generally. He pointed out the need for developing high-grade standardized products as the most important element in establishing California products in competitive markets. Searles Lake potash was instanced as one product which had succeeded in establishing itself firmly

in an intensely competitive market. Plastic magnesite guaranteed to give certain results when properly used was another example. Value concentration in the marketed product offered one of the most attractive possibilities for the exploitation of non-metallic minerals. Producers have to do something more than merely load their raw product upon the car and collect the money.

C. Colcock Jones discussed the metal-producing problems and advocated a state-wide clearing house of information on mineral deposits; investigation of freight rates; better roads and the repeal of the stock-grazing law.

Lloyd L. Root, state mineralogist, stated that Stanford University is going to establish a department of ceramics and would co-operate with the State Mining Bureau in an investigation of clay deposits. H. F. Coors discussed experiments in testing the adaptability of California ball clays as a substitute for English ball clays which are imported. Certain clays can be successfully used as substitutes when mixed with a small proportion of English ball clay.

V. O. Johnson, speaking for the sand and gravel producers, said: "as producers of railroad revenues, we are second only to coal, averaging 8,000 cars per day. Including truck and water transportation, our production approximates 500,000 tons per day, representing an increase of more than 100 per cent in the last five years. Our problems are those incident to production, transportation, and marketing—and the greatest of these is marketing." The products of the sand and gravel industry sell, he said, on the average for the country, for 65c. per ton.

Other speakers followed and in the afternoon individual section meetings were held to formulate more definitely the needs of their respective divisions. The resolutions that were prepared indicate the special difficulties under which metal and mineral producers in California labor. The general resolutions adopted by the conference are as follows:

1. Be it resolved that a statewide clearing house of the producers, distributors, and users of mineral products and industries and utilities related thereto

be formulated, such a clearing house to be under the leadership of the industrial department of the California Development Association, with the co-operation of trade organizations, chambers of commerce, and all other interested agencies of the state.

2. That this conference appoint an executive committee for the purpose of securing and maintaining active co-operative relations among the various industrial agencies of the state.

3. That this conference approve the formulating of a program to obtain the purchasing policy of the buyers of mineral products in California, in support of California, Pacific Coast and American mineral products, on a basis of price, quality and service.

4. That a plan be formulated to reduce foreign importations of mineral products in California to a minimum, in cases where such importations seriously interfere with the proper development of the mining industry in California and on the Pacific Coast.

5. That a plan be formulated to make an economic survey of the mining industry of California for the development of new markets in obtaining facts regarding mining taxation and the tariff on mineral products with a view of obtaining just protection; and to gather data on production and consumption of mineral products for use in forecasting future developments of the mining industry.

6. That a general publicity program be formulated for the mining industry of California, which is needed at the present time as an aid in marketing, and in the development of existing payrolls and in encouraging new payrolls in the mining industry of the State.

7. That a plan be formulated to obtain the active participation of the other interested states on the Pacific Coast in this development.

The idea of a statewide mineral conference originated some months ago in the mining department of the Sacramento Chamber of Commerce. It was taken up by the California Development Association, which is in effect a state chamber of commerce. The fundamental principle was to bring prospectors, producers, marketers, railroad traffic, and industrial men together in a permanent organization and to form committees each of which would have the interests of a single group in hand and which would work together when necessary. The meeting was highly successful in that it brought mining men together on a common co-operative ground. It developed the fact that transportation and its cost is one of the dominating factors influencing the non-metallic mineral production; that marketing conditions must be seriously studied; that foreign importations must be watched and dumping of various products in local markets to the detriment of domestic producers needs control; that surveys and statistical information are especially necessary to give accurate information to producers and marketers. The need for a state department of mines and mining was unanimously expressed and the conference went on record in endorsing recent legislation having for its object fundamental changes in the organization of the present State Mining Bureau.

Safety Trophy Exhibited in New York

"Sentinels of Safety," the safety trophy presented by *The Explosives Engineer*, bronze casts of which are to be awarded by the U. S. Bureau of Mines to the winners in a nation-wide mine and quarry safety contest, was exhibited privately in New York on May 20 at the studio of the sculptor, Begni del Piatta. The figure, which is shown



"Sentinels of Safety," bronze replicas of which are to be awarded to winners in the national safety contest that is now being held.

on its pedestal in one of the accompanying cuts, portrays a mother and child greeting the father upon his safe return home from work. The four panels on the pedestal depict metal mining, coal mining and quarrying scenes. Begni del Piatta is the sculptor who designed the Navy and Marine Me-



The metal mining panel on the pedestal of "Sentinels of Safety"

morial of sea gulls flying over the crest of a wave, which will be placed on the bank of the Potomac at Washington, D. C.

Three bronze replicas of "Sentinels of Safety" will be made, one for coal mining, one for metal mining, and one for quarrying and open-pit mining.

Representatives of the Bureau of Mines, *Engineering and Mining Journal-Press*, *Coal Age*, *Rock Products*, and *Cement, Mill and Quarry*, and of the Hercules Powder Co., which publishes *The Explosives Engineer*, were present at the exhibition.

Plans for Salt Lake Meeting of A.I.M.E. Arranged

Include Petroleum Session at Casper, Wyo., and Sight-Seeing Trips to Bryce Canyon and Other Points

The program of the Fall meeting of the American Institute of Mining and Metallurgical Engineers, as now arranged, will begin with a session of the Petroleum Division at Casper, Wyo., on Aug. 28. Registration for the general meeting at Salt Lake City will begin Aug. 31. This and the following three days will be devoted to technical sessions, to visiting mines, mills and smelters in the vicinity and to entertainment provided by members of the Salt Lake Section.

Arrangements are being made for three optional excursions after the meeting: one to the Yellowstone, the second to Zion National Park and Bryce Canyon, and the third to Zion National Park, Bryce Canyon and the north rim of the Grand Canyon of the Colorado. The Raymond & Whitcomb Co. will take charge of the traveling and hotel arrangements for those who wish it.

No special train service is to be arranged for members attending from points west of the Mississippi. Arrangements have been made so that those from the East may travel together over the New York Central Lines leaving New York on the evening of Aug. 27, and from Chicago on the evening of Aug. 28, arriving at Salt Lake City on the afternoon of Aug. 30. Eastern members who take either of the three excursions will find it possible to get back to New York on Sept. 13.

Members interested in petroleum will meet in Casper as stated. Aug. 28 will be devoted to technical sessions. On Aug. 29 there will be an automobile trip to the Salt Creek and Teapot fields and the new electric power plant of the Midwest Refining Co. will be visited. On Aug. 30 the party will visit Independence Rock, Ferris Mountains, Wertz-Mahoney gas fields, and Lost Soldier oil field; and will take the Union Pacific train out of Rawlins Sunday evening, arriving at Salt Lake City on the morning of Aug. 31.

The following papers will be presented at the sessions of the Salt Lake meeting:

"Deep Hole Prospecting at Chief Consolidated Mine," Charles Dobbel.

"Chief Consolidated Mining Co.'s Volatilization Plant," G. W. Wigton.

"Notes on Geology of Tintic District," G. W. Crane.

"Lead Smelting in Utah," B. L. Sackett, Carlos Bardwell, Simon Jacobson and N. H. Jensen.

"Tintic Standard Mine," James W. Wade.

"Tintic Milling Co.'s Mill," H. P. Allen and W. C. Madge.

"Flotation Development and Simplification at the Ophir Hill Consolidated Mine," R. V. Thompson.

"The New By Product Coke Plant of the Columbia Steel Corporation," C. T. Keigley.

"Blast-Furnace Plant of the Columbia Steel Corporation at Ironton, Utah," P. W. Jackson.

"Iron Fields of the Iron Springs and

Pinto District, Iron County, Utah,"
Duncan MacVichie.

"Leaching in Place of Ohio Copper
Company's Mine," Arvil Anderson.

"Evolution in the Preparation of Ores
for Lead Blast Furnaces," D. W. Jessup.

"Method of Unloading Ores and
Coarse Crushing Practice at Magna
Plant of Utah Copper Co.," B. E. Mix
and L. M. Barker.

"Shovel Operations at Bingham, Utah
Copper Co.," H. C. Goodrich.

"Application of Cottrell Process in
Lead and Copper Smelting," A. L.
Labbe.

"Ore Deposits and Their Relation to
Structural Geology," J. J. Beeson.

In the course of the Salt Lake meet-
ing a trip will be made to Bingham,
Magna, and Garfield to the mine and
mills of the Utah Copper Co. and the
copper smelter of the American Smelt-
ing & Refining Co.; also to the latter
company's lead plant at Murray, the
United States Smelting Co.'s lead plant
at Midvale and the Columbia Steel
Co.'s plant at Ironton. Trips will also
be made to the Tintic district and Park
City. At Park City, the mill of the
Silver King Coalition company will be
inspected. In the Tintic district the
mines and mills of the Tintic Standard
and the Chief Consolidated companies
will be visited, as well as various other
mines, including the Grand Central and
Mammoth. A trip to Tooele will also
be made to the mill and smelter of the
International Smelting Co.

Society of Economic Geologists Meets at Columbia

The Society of Economic Geologists
held its annual technical meeting on
Friday, May 22, 1925, at Schermerhorn
Hall, Columbia University, New York
City. The address of the president,
Dr. C. K. Leith, was on the "Origin of
the Lead and Zinc Ores of the Missis-
sippi Valley." Many interesting papers
were presented, including an essay on
the origin of the Permian rock phos-
phates of Idaho, by G. R. Mansfield; on
the mineral resources of Maranhão,
Brazil, by Eugene W. Shaw; on the
genesis of magnetite deposits of Van-
couver Island, by Dr. W. L. Uglow; on
the origin of gypsum on the alteration
of limestone, by F. A. Wilder; on the
natural history of pegmatites, by Frank
A. Hess; on microstructure as an index
of ore genesis, by L. C. Graton and
R. P. Koenig; on successive crystalliza-
tion around rock fragments in veins, by
J. E. Spurr; on the origin of native
arsenic from northern Idaho, by Ed-
ward Sampson and J. L. Gillson; on
paragenesis at the Porvenir Silver
mine, Huanuni, Bolivia, by Waldemar
Lindgren; on replacement in the tin-
bearing veins of Caracoles, Boliva, by
Waldemar Lindgren; on resorption and
its relation to the hematite veins in the
Grenville granite, by G. W. Bain.

Luncheon was at the Faculty Club at
Columbia University. The geologists
took train in the evening for Pennsyl-
vania, where Saturday was spent in a
very pleasant visit to one of the inter-
esting iron mines of the East, where
the members of the party were most
hospitably entertained and had ex-
pounded to them the peculiarities of
Pennsylvania iron ore deposits.

U. S. Chamber of Commerce Meets

Dedicates Its New Building in Washington—Federal Trade Com-
mission's Creed Announced—Hoover Talks on Waste

THE ANNUAL MEETING of the
United States Chamber of Com-
merce was held in Washington, D. C.,
May 20 to 22.

Chief Justice Taft, former President
of the United States, paid a notable
tribute to the American business man
in the course of remarks at the dedi-
cation of the new building of the
Chamber in Washington. "Taken to-
gether," he said "you have no selfish or
other aim, narrow and contracted, that
blinds you to the general good. You
are not cranks. You are not men of
one idea. As much as any set of men,
you have in you, as a whole, the
catholic spirit of good will to all ele-
ments of our society."

In commenting on the need for an
intelligent public opinion, he com-
mended the Chamber for its efforts in
arousing the citizen "to a sense of re-
sponsibility in a quasi-judicial self-
examination of his own view and by
comparison with the views of his fel-
lows bring about definite conclusions out
of a nebulous, lazy, ignorant condition
of mind that so often persists, even
among the intelligent, but indifferent."

At the dedication ceremonies Mr.
Grant, in his capacity as president of
the Chamber, called attention to the
fact that the new edifice occupies the
site of a house occupied by Daniel Web-
ster when he was Secretary of State.

Herbert Hoover addressed the meet-
ing on "Waste in Government." He
considered only those wastes that arise
from improper organization and from a
mixing of administrative functions with
those of a semi-judicial and semi-
legislative character. He declared that
there was need for three primary re-
forms: First, to group together all
agencies having the same predominant
major purpose under the same admin-
istrative supervision; second, to sepa-
rate the semi-judicial, the semi-legisla-
tive and advisory functions from the
administrative functions, placing the
former under "joint minds"—that is,
boards, commissions and committees—
the latter under single responsibility;
third, to relieve the President of a vast
amount of direct administrative labor
by putting the independent establish-
ments now reporting to him into the
existing executive departments.

As an indication of the wastes in sep-
arating agencies having the same major
purposes he showed that public works
construction is now performed by four-
teen bureaus scattered through nine de-
partments, that the conservation of
natural resources is covered by eight
bureaus in five departments, and that
there are direct aids to the merchant
marine in fourteen bureaus in six de-
partments. This scattering results in
constant conflict of view with the gov-
ernment itself, preventing the forma-
tion of a definite and consistent policy.
At the same time needless expense is
imposed upon the public in seeking the
information it wants, settling the de-
mands upon it and determining the
regulations by which it is required to
conduct its business. Within the gov-
ernment itself there is also obviously

a great waste of the taxpayers' money.

That a plan has been devised to get
wealth out of Germany without dis-
rupting industry in other countries was
revealed at the dinner of the American
Section of the International Chamber of
Commerce. The idea is to apply Ger-
man production capacity to wealth-
creating enterprises, particularly in
countries where development has been
retarded. Thus no market would be
taken away from anyone. This was
held to be vastly superior to the dump-
ing of goods for current consumption
upon an amply supplied market, which
would mean the displacing of the out-
put of plants in other countries.

Thoughts along the same line were
expressed by Henry M. Robinson, of
Los Angeles, a member of the Dawes
Commission.

The fact that a practical way had
been found to transfer reparation
credits out of Germany was one of the
promising indications of an improved
European situation. Pierre Jay, chair-
man of the board of the Federal Re-
serve Bank of New York, cited the re-
turn of the British to the gold standard
as another momentous development
tending toward the rapid improvement
of the world situation.

A domestic development regarded as
of encouraging and far-reaching import
was the announcement of a new creed
by the Federal Trade Commission. In
part it states:

"We do not believe that success is a
crime.

"We do not believe that failure is a
virtue.

"We believe that 90 per cent of
American business is honest. . .
anxious to obey the law.

"We want to help this 90 per cent
of honesty.

"We want to control or destroy the
10 per cent that is crooked."

The significance of this change of
attitude was recognized as going
deeper than the activities of the Fed-
eral Trade Commission. The appoin-
tive power of the administration was
used in such a way as to bring about
this change of policy, which is taken
to mean that the creed really sets forth
the administration's attitude toward
business.

Swasey and Rand Honored at Engineering Foundation Dinner

The Engineering Foundation began
its second decennium at its regular
quarterly meeting May 14. The event
was marked by a subscription dinner
at the Union League Club, New York,
to Ambrose Swasey, the founder, given
by present and former members of the
Foundation, the trustees of the United
Engineering Society, and the officers
and directors of the four national engi-
neering societies.

On behalf of the Foundation Board,
Mr. Adams delivered to Past Chairman
Charles F. Rand a beautifully printed
and bound copy of a resolution adopted
at the annual meeting in February in
appreciation of his five years' service.

New Machinery and Inventions

The Golden Cycle "Superthickener" and Clarifier

A New Development in the Field of Hydrometallurgy and Chemical Manufacture

By Noel Cunningham

Metallurgical Engineer, York, Pa.

A THICKENER and clarifier invented by H. S. Coe has been perfected by A. L. Blomfield, manager of the Golden Cycle Mining & Reduction Co., Colorado Springs, Col., and his operating staff. During the last two years a full-sized working unit 30 ft. in diameter by 12 ft. deep has been working experimentally at the Golden Cycle mill, and careful operating data have been recorded, which form the basis of this article. The new device is known as the Golden Cycle "superthickener" and clarifier.

Heretofore the function of thickening has consisted merely in the separate removal of settled solids and supernatant liquid from a tank receiving solids in more or less dilute liquid suspension. Entering the thickening tank, the solids settled as freely as consistent with the upward buoyant currents of the liquid approaching the overflow weir; zones of density increasing from that of the feed to that of the underflow occurred from near the surface of the tank to its bottom. The effect of these zones of increasing density was to retard the free settling rate of the solids and limit the settling capacity of the thickener. The maximum density obtainable was that to which the solids would freely settle in the time during which they remained in the tank.¹

The action of the new thickener is to lower or draw down in the tank the level of the thickening zones, thus greatly increasing settling rate of solids, with consequent increase in capacity, and to dewater and compact the bottom layer of settled solids, enabling the delivery of very thick underflows. This is accomplished by providing in a thickening tank a bottom porous only to the liquid in which the solids are suspended and mechanical means for either continuously or periodically cleaning the surface of this porous bottom so as to maintain a permeable filter medium. The filtrate is drawn through this bed continuously under limited static head.

Fig. 1 shows graphically the comparative effects of ordinary thickening and thickening with the new device. This is taken from actual records of sampling an ordinary thickener and a "superthickener" of the same size at various depths and shows clearly why the latter can handle a greater tonnage than the ordinary thickener and at the same time deliver an underflow equivalent to air-dried vacuum filter cake.

¹For a complete discussion of the action of slimes in settling tanks refer to "Methods for Determining the Capacities of Slime-Settling Tanks," by H. S. Coe and G. H. Clevenger, *Trans. A.I.M.E.*, September, 1916; also "Methods for Determining the Capacities of Slime-Thickening Tanks," by R. T. Mishler, St. Louis Meeting, *A.I.M.E.*, 1917.

Fig. 2 shows the effect of decreased density column on settling rate and further emphasizes the value of superthickening. Settling rate 5 ft. below the surface in the "superthickener" was 4½ ft. per hour, as compared with a settling rate of 1½ ft. per hour 6 in. below surface in an ordinary thickener.

Fig. 3 shows general arrangement of the "superthickener" which is in operation at the Golden Cycle plant. In a 30 by 12 ft. tank a 6-in. false bottom consisting of studding, slats, cocoa matting, and burlap supports a bed of clean, fine sand. A superstructure across the top of the tank carries the actuating mechanism. This consists of a worm-gear-driven quill or torque tube, through which passes a left-hand threaded shaft feather keyed to the quill and rotating with it. The threaded shaft protrudes through the quill and to its lower end is attached a steel-shod spiral sweep, the end of which just clears the inner wall of the tank. The spiral is caused to revolve by drive arms attached through hinged joints to a spider casting on the quill. The threaded shaft engages a geared nut riding on top of the quill, and this nut supports the weight of the threaded shaft and the spiral sweep. At every revolution of the quill, a ratchet-and-pawl actuated pinion revolves the geared nut sufficiently to lower the spiral sweep a measured distance into the bed of sand in the tank. In this way all settled material as well as a very thin film of sand is removed at each revolution of the mechanism. The length of thread on the shaft is 5 ft. so that a 5 ft. deep bed of sand can be cut away before renewal.

Sand cuts varying from ¼ in. to 8 in. per twenty-four-hour day have been tried, and Table I gives percentage effectiveness of the "superthickener" on a tonnage fed basis at various cuts operating on Golden Cycle slime, the capacity of an ordinary thickener of same size running in parallel on identical feed being taken for comparison at 100 per cent. The test on each cut lasted for a period of from eight to ten days.

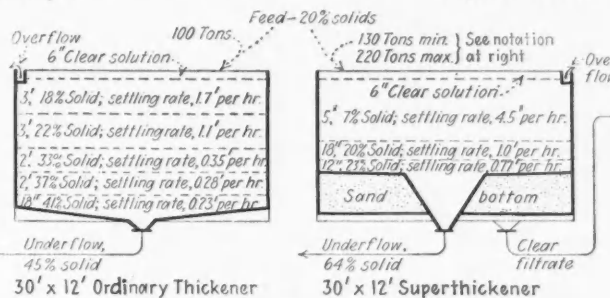


Fig. 1—Diagram illustrating effect claimed for thickening with new Golden Cycle "superthickener"

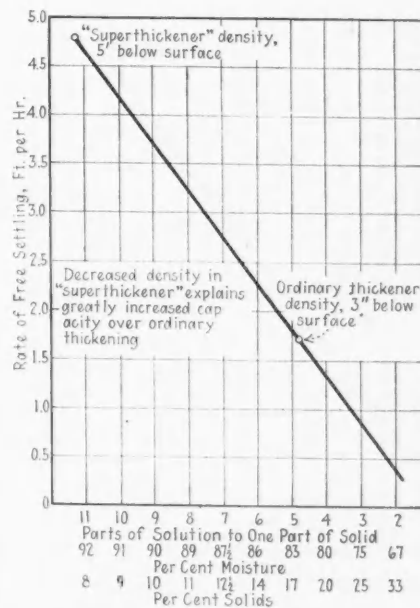


Fig. 2—Slime settlement rates at various dilutions—Golden Cycle Mining and Reduction Co.

Table I

Tonnage handled by ordinary thickener, 100 per cent. Solid content of underflow, 45 per cent.

Superthickener
Solid content of underflow, 64 per cent.

Depth of Sand Cut per Twenty-four Hours	Tonnage Handled, That of Ordinary Thickener in Parallel Equaling 100 Per Cent
¼ in.	130%
½ in.	150%
¾ in.	195%
1 in.	218%
2 in.	225%

In operating the "superthickener," density of underflow is controlled by the fluidity of the superthickened pulp. At the Golden Cycle the material being thickened is 95-98 per cent minus-200-mesh, slime-bowl classified from roasted Cripple Creek ore; this slime will settle to about 50 per cent moisture in twelve hours; air-dried vacuum-filter cake is 67 to 68 per cent solids. It is possible with a 20-in. head on the "superthickener" filter bottom to hold the underflow, which is lifted by diaphragm pump, at over 70 per cent solids for a day at a time, but at this thickness it is necessary to "ride" the pump continuously. Maintaining the underflow at 64 per cent solids, the diaphragm pump needs no attention. Many other pulps flow freely with a solid content as high as 80 per cent. In general "superthickener" underflow may be

Owing to reduced density of column in "superthickener," amount of solids at any time in tank is greatly reduced. Allows stopping and starting under full load at will. Superthickener tonnage can be increased at will, from minimum to maximum, without affecting density column by regulation of sand cut. See Table I.

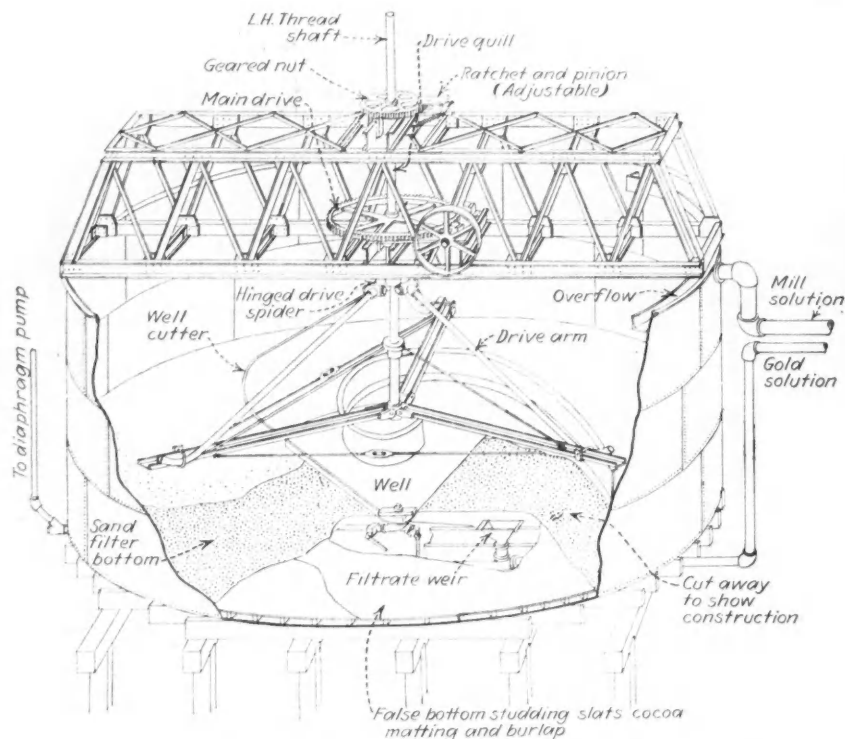


Fig. 3—Sketch showing general construction of Golden Cycle "superthickener" and clarifier

maintained as thick as vacuum filter cake, if desired, but where diaphragm pump is used, a solid content slightly lower than filter cake will probably be found more practicable.

Depending upon the material being handled, the suction (that is, pressure on the filter medium) may vary from 0.1 in. to 20 in. of mercury. Thus with a feed of 20 per cent solids, which was the basis of tests in Table I, the filtrate pipe was carried at an average of 20 in. below water level in the tank, equivalent to a static head of about 0.75 lb. per square inch, or a suction of about 1.5 in. of mercury. When the machine is to handle a very dilute feed and it is desired to eliminate overflow and put all the liquid through the sand filter bottom, a suction pump is used and may develop as high as 20 in. of vacuum.

It is apparent from data available that the "superthickener" affects a wide field of operation. A single machine not only functions as an ordinary thickener of greater area, but does the work of a filter as well, at the same time delivering an effluent cleaner than that obtainable from any filter of the vacuum or pressure type.

APPLICATION IN CYANIDE MILLING

It is probable that the "superthickener" has one of its most immediate applications in cyanidation. With little alteration of existing plant it makes possible:

1. Washing of fine sand tailing and colloidal slime simultaneously.
2. Increased tonnage through C.C.D.² and at the same time underflows at a very low moisture content approximating air-dried filter cake.
3. Crystal-clear gold solution without separate clarification and reduction of precipitation ratio.

²Continuous counter-current decantation.

4. Elimination of colloid in milling and washing solutions.

5. Handling through C.C.D. abnormally large tonnage during short periods without increasing dissolved loss or fouling mill solutions.

With regard to simultaneous washing of fine sand and colloid, there is an important distinction between "all sliming" and "fine grinding." Where only a part of the ore needs extremely fine grinding the only excuse for going to the expense of "all sliming" is that simplification of plant is made possible, and this simplification sometimes sufficiently cheapens operation to balance increased grinding cost. The ideal treatment would consist in grinding the constituents of an ore only as fine as demanded for best economic extraction.

The drawback has been sand segregation in thickeners and filters, and this the "superthickener" overcomes. In the "superthickener" the more fine sand in feed the better, as increased permeability of settled solids increases filtrate flow, thereby increasing thickener capacity for the same sand cut or decreasing the sand cut necessary for

the same capacity. The action of the "superthickener" is to eliminate segregation in the tank, and underflow is too thick to allow segregation in the discharge.

The second point, increase in tonnage through C.C.D., is sufficiently explained by consideration of performance under discussion of Fig. 1 and Table I. It is apparent that the "superthickener" in a single tank and in a single operation approximates results obtainable in an ordinary thickener of larger area in combination with a vacuum filter, at a lower cost for installation than the filter and with the simplicity and low operating cost of the thickener.

Crystal-clear gold solution is obtainable as filtrate from the "superthickener." By regulating the sand cut the quantity of filtrate can be varied, if desired, and the sand-filtered effluent is at all times entirely free from suspended matter; no cloth filter medium ever gives at all times an unclouded filtrate. Improvement in quality of precipitate and increased bullion fineness may be expected, and the cost of clarification is eliminated. This is entirely borne out by experience at the Golden Cycle. Precipitation ratio may be reduced about in proportion to reduction made possible in C.C.D. underflows.

Elimination of colloid in milling and washing solutions and of the tendency of suspended colloid to build up to saturation point in mill solution is an advantage of the "superthickener." Whenever a bad run of ore breaking to an excess of slime comes into the mill and, in consequence, costs and dissolved losses tend to go up, or when, for a short period, it is desirable to push C.C.D., an increase in sand cut speeds up the filtrate flow, thereby pulling down the density column and increasing capacity as shown in Table I.

In many cases when the feed to the cyanide mill contains water-soluble cyanicides, grinding is done in water to remove the undesirable element. Filtration to reduce excess water ahead of cyanidation is often more expensive than precipitating and discarding waste solution equal to the quantity of water thus introduced. Dewatering under these conditions is in most cases done either by decantation or ordinary thickening. Superthickening equipment in the same tanks used for decantation or ordinary thickening will, by reducing water going into cyanide treatment, reduce the cost of precipitation and cyanide loss, and at the same time

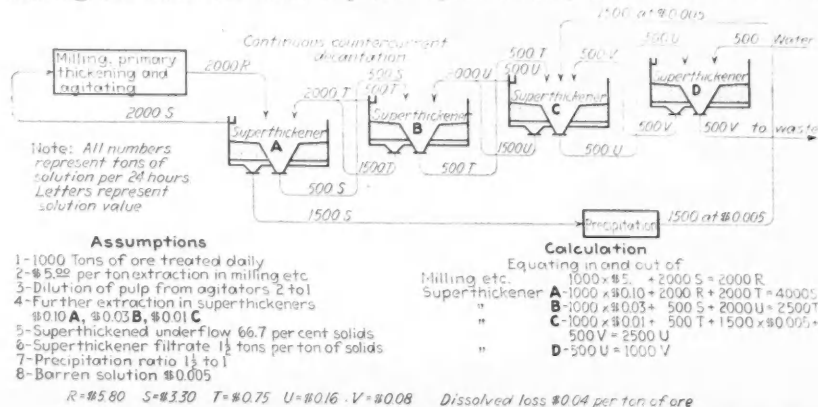


Fig. 4—Cyanide mill flow sheet as simplified by use of "superthickener"

conserve the heat in the mill solutions in winter.

The conventional cyanide mill flow sheet, Fig. 4, illustrates the simplicity of plant design made possible by the new thickener. Here with \$5.14 dissolved per ton of ore, a 1½ to 1 precipitation ratio, four steps of "superthickener" C.C.D., in the first three of which dissolution occurs, a possible dissolved loss in tailing of only 4c. per ton is indicated.

In considering the use of the new machine, allowance must be made for either spare units or interruption of treatment during periodical renewal of the sand filter bottom. The time and equipment necessary and the material available are matters for consideration in each individual case. With a half-inch sand cut per twenty-four hours, in continuous operations a 5-ft. deep sand bottom will need renewal every four months. Dry weight of sand required for a 5-ft. deep sand filter bed in tanks of various diameters is given in Table II.

Table II

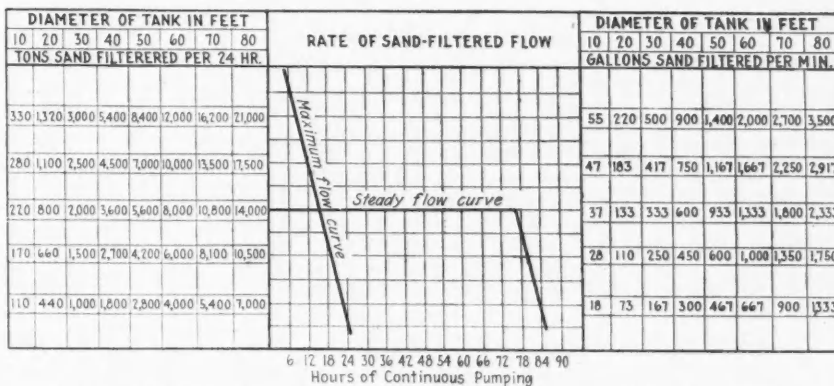
Dry Weight of Sand (2.6 Sp. Gr.) in 5 Ft. Deep "Superthickener" Sand Filter Bottom

Diameter of Tank	Tons Sand	Diameter of Tank	Tons Sand	Diameter of Tank	Tons Sand
10	15	30	150	70	816
15	37.5	40	270	80	1,066
20	66	50	420	90	1,350
25	105	60	600	100	1,666

The material for sand bottom must be granular and practically free from colloid; it may be coarse or fine, but should contain sufficient very fine grains to close the surface to colloidal penetration. Table III gives screen tests on three different sand bottoms taken at random from renewals at the Golden Cycle. The material was bowl-classifier sand going to leaching tanks.

None of those bottoms showed colloid penetration and were bypassed just as they came from the material going to sand leaching into the superthickener, which was drained for the purpose. It will be noted that there was considerable difference in fineness between the second and third, but both gave identical results.

Where flotation concentrate is to be thickened ahead of filtration, fine table concentrate is generally available and makes an ideal filter bottom. In thickening fine washed coal with the new machine, a granular element for filter bottom may be classified out of the feed. In cyaniding where the classifier tube mill closed circuit contains no coarse gold, tube-mill feed might be used. In this case the action in the "superthickener" during four months should completely leach out the gold and silver content, but in the final



Partially clarified overflow obtainable in addition to, and simultaneously with, sand clarified flow. May be large or small depending upon the character of the suspended solids and the purposes for which the overflow may be used.

Fig. 5—Curves showing capacity of "superthickener" operated as a clarifier

steps of C.C.D. this dissolution would run up dissolved loss, and where a barren bottom medium is available it would be preferable. In clarification, wherever sand is hard to get it would probably pay to classify out and re-use the sand from the discharge at the time of making a cut. Where chemical or physical contamination will result from the small admixture of sand bottom with settled material in thickening with the new machine, it will generally pay to use the superthickener as a clarifier.

In many industries it is desirable to remove from dilute suspension an extremely fine colloid that owing to its slow settling rate will not thicken and where without thickening filtration is out of the question. With no change in arrangement the "superthickener" can be used for either thickening or clarification. The tank may be shallower, a flat instead of an inclined bottom may be used, and the depth of the sand bed may be reduced, if desired. As much greater filtrate flows are required, pump instead of static head is depended upon for drawing the liquid through the filter bottom. At the Golden Cycle there had been in use a vacuum 38-leaf clarifier having 2,700 sq.ft. canvas filter surface. This would clarify 2,000 tons of solution per twenty-four hours, equivalent to 333 gal. per minute. Every five days the leaves had to be cleaned with solution hosed under high pressure and every twenty days they had to be acid-treated and sand-blasted; the life of canvas was approximately six months. One 30-ft. diameter sand clarifier (that is, the "superthickener" used as a clarifier) having only 700 sq.ft. of filter surface now handles this same solution tonnage, using less than ¼ in. of sand per week, equivalent to 0.6 ton. The mechanism is rotated only when settled, and caked solids on filter bottom reduce flow below 2,000 ton rate.

Fig. 5 shows two characteristic

clarifier capacity curves. The "maximum flow" curve shows the manner in which the filtrate falls off when all the liquid possible is pulled through the bottom. In the 30-ft. diameter tank "maximum" flow falls off from rate of 4,000 tons per twenty-four hours immediately after making a sand cut to 1,000 tons per twenty-four hours after twenty-two hours' pumping. To obtain best results, only current requirements are drawn through the bottom. The "steady flow" curve, Fig. 5, shows the effect of drawing steadily at the rate of 2,000 tons per twenty-four hours after making the sand cut; after seventy-six hours' pumping at this rate the deposit of mud on the filter cut down the flow and during the following eight hours the rate dropped to 1,000 tons per twenty-four hours. Time between sand cuts in clarification will, of course, vary with the material; the gummier the solids and the greater their quantity the more frequent the cut. In intermittent clarification, with the worst material and if sufficient area is provided, a 5-ft. deep sand filter bottom will last from one to four years.

Power consumption is small—0.3 hp. for a 30-ft. diameter "superthickener" where underflow, overflow and filtrate are removed by gravity. The diaphragm pump for lifting the underflow consumes about 4 hp. When the "superthickener" is used as a clarifier, and the filtrate is pumped, the power consumed will vary with the displacement and head against which the liquid is pumped; vacuum of plunger pumps are adapted to this service.

Mr. Blomfield and the Golden Cycle staff are to be congratulated upon having developed a principle and perfected a machine of great value to industry. Not the least interesting feature of the development is the manner in which the interests of all concerned have been safeguarded. The men who have contributed their work and ideas during the last five years have formed a stock company, with A. E. Carlton as president. Mr. Carlton is president of Golden Cycle, Cresson Gold Mining Co., The Holly Sugar Co., and Western banks and operations and has characteristically joined his staff in this progressive move. In this company the patents are vested, and any returns will thus be assured to the men who actually conceived and executed the idea.

Table III

Screen Tests "Superthickener" Sand Filter Bottom

Mesh	April 26, 1923		Oct. 1, 1923		May 23, 1924	
	Per Cent Actual	Per Cent Cumulative	Per Cent Actual	Per Cent Cumulative	Per Cent Actual	Per Cent Cumulative
+20	1.7	1.7	18.0	18.0	.....	.....
+30	14.1	15.8	22.0	40.0	.....	.....
+40	18.9	34.7	14.0	54.0	0.5	0.5
+60	31.9	66.6	23.0	77.0	14.9	15.4
+100	11.3	77.9	10.0	87.0	18.9	34.3
+150	.....	.....	6.0	93.0	35.7	70.0
+200	3.5	92.5	3.0	96.0	18.1	88.1
-200	4.0	100.0	4.0	100.0	11.9	100.0

The Market Report

Daily Prices of Metals

May	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
21	13.375	54.25	55.25	8.05	7.85@8.15	6.95
22	13.35@13.375	54.125	55.125	8.20	8.00	7.00
23	13.375	54.25	55.25	8.20	8.00	7.00
25	13.375	54.375	55.375	8.30	8.15	7.025@7.05
26	13.35@13.375	54.625	55.625	8.35	8.15	7.10
27	13.35@13.375	55.25	56.25	8.35	8.15	7.10@7.15
Av.	13.369	54.479	55.479	8.242	8.075	7.035

*The prices correspond to the following quotations for copper delivered: May 21st, 13.625c.; 22d, 13.60@13.625c.; 23d and 25th, 13.625c.; 26th and 27th, 13.60@13.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of Mining Journal-Press and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

been keener in Europe than in the domestic market. Prices as low as 13.475c. f.a.s. were made, although business was also placed at 13.50c. and 13.55c. f.a.s. In the domestic market prices held fairly firmly at 13 $\frac{1}{2}$ c., delivered, with now and then some shading of this level taking place. Consumers in the Middle West, where a freight rate above normal holds, paid 13 $\frac{3}{4}$ c. for their copper. There is plenty of copper available. Transportation from refinery to factory is excellent, so consumers are in no haste to stock the metal.

Mixed reports are at hand about the business of the copper consumers. Some statements of consumers indicate a falling off in wire orders and a good brass business. Others say wire business has been more than satisfactory.

It is reported that two important copper companies in the Southwest have decided to cut production a million pounds each. This is in line with the curtailment policy of other companies.

Lead Sold Above 8 $\frac{1}{2}$ c.

The American Smelting & Refining Co. made two advances in its contract price for New York lead during the week ending today, going from 8c. to 8.15c. on Friday, May 22, and to 8.25c. on Monday, May 25. These prices were, however largely nominal except for contract sales, and purchasers in the open market have again been compelled to pay from $\frac{1}{4}$ c. to $\frac{1}{2}$ c. more than the smelting company's official price. The open-market sales were in considerably smaller volume than the contract business. In the St. Louis market, the leading producer continues its effort to prevent a runaway market and to make conditions as stable as possible. Several hundred tons have been released each day to old customers who actually require the metal for consumption, at prices from $\frac{1}{4}$ c. to $\frac{1}{2}$ c. less than those generally quoted. Naturally this producer has been inundated with inquiries, most of which had to be turned down or postponed. In the last three days, this interest has released lead at 8c. per lb., whereas the general quotation for June lead has been 8.45@8.50c., St. Louis, and odd carloads have sold as high as 8 $\frac{3}{4}$ c.

The present condition is a duplicate of that which existed up to the middle of January, when a high of about 10 $\frac{1}{2}$ c. was reached. Few expect the present advance to continue to that level, as consumption is usually not so great during the summer months. Production is likely to increase somewhat, and also no great scarcity of prompt lead is in evidence abroad. Demand so far, it must be admitted, has shown practically no slackening, though corrodors complain of dull business; still they have bought a good deal of corroding lead in the last week. Figures just released by the government show that the sales of lead paint showed a greater increase in 1924 over 1923 than did those of zinc, despite the advance in price.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
21	60 $\frac{1}{2}$	61 $\frac{1}{2}$	63 $\frac{1}{2}$	248 $\frac{1}{2}$	250 $\frac{1}{2}$	32 $\frac{1}{2}$	32 $\frac{1}{8}$	34 $\frac{1}{16}$	33 $\frac{7}{16}$
22	60	61	63 $\frac{1}{2}$	249 $\frac{3}{4}$	251	32 $\frac{3}{16}$	32 $\frac{3}{16}$	34 $\frac{1}{2}$	33 $\frac{9}{16}$
25	60 $\frac{1}{2}$	61	63 $\frac{1}{2}$	251 $\frac{1}{4}$	251 $\frac{1}{2}$	32 $\frac{9}{16}$	32 $\frac{9}{16}$	34 $\frac{9}{16}$	33 $\frac{3}{4}$
26	60	61	63 $\frac{1}{2}$	252 $\frac{1}{2}$	252 $\frac{1}{2}$	32 $\frac{3}{4}$	32 $\frac{1}{2}$	35	33 $\frac{3}{4}$
27	60	61	63 $\frac{1}{2}$	255 $\frac{1}{8}$	255 $\frac{1}{4}$	32 $\frac{5}{8}$	32 $\frac{1}{2}$	35 $\frac{1}{2}$	34

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
21	4.85 $\frac{1}{2}$	67 $\frac{1}{2}$	31 $\frac{1}{4}$	84s 11 $\frac{1}{2}$ d	25	4.85 $\frac{1}{2}$	67 $\frac{7}{8}$	31 $\frac{5}{16}$	84s 11 $\frac{1}{2}$ d
22	4.85 $\frac{5}{8}$	67 $\frac{3}{4}$	31 $\frac{1}{8}$	84s 11 $\frac{1}{2}$ d	26	4.85 $\frac{3}{4}$	67 $\frac{7}{8}$	31 $\frac{5}{16}$	84s 11 $\frac{1}{2}$ d
23	4.85 $\frac{1}{2}$	67 $\frac{1}{2}$	31 $\frac{1}{4}$	.....	27	4.85 $\frac{1}{2}$	67 $\frac{7}{8}$	31 $\frac{5}{16}$	84s 11 $\frac{1}{2}$ d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Copper Steady; Lead and Zinc Markets Move Upward

New York, May 27, 1925—The metal markets have been generally quiet. Even in lead, where the greatest activity was shown, the market has not shown the briskness associated with previous rising movements in price. Copper continues remarkably steady, which is most unusual for the red metal with its frequent and often violent fluctuations. Zinc, for a change, has had a spurt of activity. Sales have been larger than for many weeks and the price has moved well over 7c. Nothing of any consequence has occurred in the markets during the week to alter their position. This is not the season, ordinarily, for a great rush to buy.

Copper Market Unchanged at 13 $\frac{1}{2}$ c.

Since the middle of April the price of copper has varied within narrow limits. This is not the behavior one customarily expects of copper. A principal reason for it is the fact that London prices have not fluctuated much. When speculation occurs abroad, or heavy buying and selling, the price tends to move frequently rather sharply. Although export buying of copper has been good lately, export prices have also been steady. In both markets, however, there has been a tendency to shade prices. The scramble for business has

Most lead producers still have moderate amounts of June lead to offer. Corroding grades command a premium of \$2 to \$3 per ton over common lead.

Zinc Now Over 7c.

Advances in the price of Prime Western zinc have carried the metal to about 7½c. per lb., East St. Louis. The strength of the market has been owing mainly to the good buying by brass mills and an increased amount of metal sold to Europe. Brass Special zinc has also been sold at a premium of ten points over Prime Western. Galvanizers have only purchased minor amounts of zinc. Had they participated in the buying, the price might have risen more rapidly than it did. Their support is required in a healthy zinc market. High-grade slab zinc continues to be sold for between 8½c. and 8¾c. per lb., delivered.

Tin Advances Slightly

American demand has not been great and has been confined largely to mixed-metal manufacturers and dealers, but the price of tin has hardened to 56c. or better today. London prices have advanced daily, owing, it is said, to buying by Vivian, Younger & Bond for consumptive demand. Forward deliveries in New York have sold from ½c. to ¼c. below the prices of spot.

Advance in Price of Silver

Silver broke away this week from its recent narrow price range, and rose to 67½c. in New York and 31½d. in London. Chinese buying and more active demand from India caused the advance. The London price declined ¼d. today, but the market in New York reflected the decline only slightly if at all. Offerings in this market are relatively light, and the tone at the moment is steady.

Mexican Dollars: May 21st; 51½c.; 22nd, 51¼c.; 23rd, 52c.; 25th, 26th and 27th, 52½c.

Foreign Exchanges Weaker

Francs and lire have been under pressure in the last few days. Closing cable quotations on Tuesday, May 26, were as follows: francs, 5.05c.; lire, 3.98875c.; and marks, 23.81c. Canadian dollars continued at par.

Correction—The quotation on sterling exchange for April 15 was incorrectly given in a few copies of the April 18 issue that got into the mails. The correct figure was \$4.78.

Gold—The gold quotation for April 23 was incorrectly cabled and printed as 85s 6d. The correct quotation was 86s. 5d.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £118.

Antimony—

Chinese brands, 16½@17c. per lb.

Cookson's "C" grade 17½@18c.

Chinese needle, lump, nominal, 10c.

Standard powdered needle, 200 mesh, 11½@13c.

White oxide, Chinese, 99 per cent Sb₂O₃, 16c. nominal.

Bismuth—\$2 per lb., in ton lots. London, 7s. 6d.

Cadmium—60c. per lb.

Iridium—\$375@\$400 per oz. London £70.

Nickel—Ingot, 31c.; shot, 32c.; electrolytic, 38c.; London, £172½ per long ton.

Palladium—\$79@\$83 per oz. London £16.

Platinum—\$120 per oz. refined. London, £25 per oz.

Crude, \$115.

Quicksilver—\$82 per 75-lb. flask. San Francisco wires \$81.67. Quiet. London £13½.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the prices given in the May 9 issue.

Metallic Ores

Tungsten Ore—Per unit, N. Y.:

High-grade wolframite \$11@\$11.50 per unit. Ordinary quality, \$11. Scarce.

High-grade Western scheelite, \$11 nominal.

Chrome, Galena Radio Crystals, Iron Ore, Manganese, Molybdenum, Tantalum, and Vanadium Ores are unchanged from May 9 quotations.

Lead Higher—Zinc Unchanged

Joplin, Mo., May 23, 1925

	Zinc Blende	Per Ton
High	\$53.60
Premium, basis 60 per cent zinc	\$50.00@\$52.00
Prime Western, 60 per cent zinc	\$47.50
Fines and slimes	\$46.00@\$44.50
Average settling price, all..	\$47.12

	Lead Ore	Per Ton
High	\$107.50
Basis, 80 per cent lead	\$105.00
Average settling price, all..	\$96.05

Shipments for the week: Blende, 12,626; lead, 1,929 tons. Value, all ores the week, \$780,200.

Lead is known to have sold on \$105 basis, and rumor offers a higher price level that is unconfirmed.

Buyers and sellers continue to contend over the basis price of zinc, sellers asking \$50 basis prime Western, and some of them holding their ore.

Production is still 1,500 tons per week below normal outputting conditions, with a number of the larger mills idle for general overhauling.

Local representatives of Belgian interests report 1,000 tons purchased for export.

Platteville, Wis., May 23, 1925

	Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	\$50.00
Lead, basis 80 per cent lead	\$105.00

Shipments for the week: Blende, 1,025 tons; lead, 40 tons. Shipments for the year: Blende, 15,822; lead 807 tons. Shipments for the week to separating plants: 1,777 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous

Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from May 9 prices.

Mineral Products

Arsenious Oxide (White arsenic)—5c. per lb.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and Zinc Oxide are unchanged from May 9 prices.

Ferro-Alloys

Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrouanium and Ferrovandium are unchanged from the prices given in the May 9 issue.

Metal Products

Copper Sheets—Base price 21.75c. Wire, 15.875c.

Nickel Silver, Yellow Metal, Zinc Sheets and Lead Sheets are unchanged from the issue of May 9.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and Zirkite are unchanged from May 9 prices.

Finished Steel Prices Steady

Pittsburgh, May 26, 1925

With the exception of sheets, the important finished steel commodities have been very steady since their last reportable decline five weeks ago. Bars, shapes and plates are a shade firmer than a week ago. Sheets have gone to new low levels, selling at as low as 3.20c. for black and 4.20c. for galvanized, but buyers are now offering third quarter contracts, which are refused, and a rebound from prices now showing losses to the mills may start at any time.

Sheet bars are quotable down from \$37 to \$35, but the old figure had been nominal, due simply to first quarter contract tonnages at that figure having held over.

The steel industry is operating at close to 70 per cent, representing little decrease this month, and with an outlook for not under 60 per cent in July.

Pig Iron—Since the decline in Valley foundry iron to \$19, furnace, buying has increased, some of the purchases being for delivery through September. The melt is reported to have increased, while buyers' stocks are well liquidated. Bessemer and basic have declined 50c. more, to \$19.50 and \$18.50 respectively, and remain inactive.

Connellsville Coke—A second half furnace coke contract has been made at about \$3.25 and there are three or four other inquiries in the market. The spot market is dull, with furnace at \$3 and foundry at \$3.75@\$4.25.

Company Reports

North Star Mines Co.

Gold; California

During 1924 the production of the North Star mine was \$871,472.41. Expenses for current operation amounted to \$755,025.35 and for development to \$184,816.36, a total outlay for operation and development of \$939,841.71, resulting in a loss of \$68,369.30. Sundry expenses at the Champion mines amounted to \$2,415.47, while \$41,007.43 was received from interest and dividends on invested funds, so that the net current loss for the year was \$29,777.34, and the deficit, including allowance for depreciation, was \$52,800.21. No further allowance was made for depletion, the book value of the company's mining property remaining at the more or less nominal figure of \$20,609.80. Up to the end of 1924 the North Star mine maintained its good record of production, but under existing conditions, with decreased yield per ton and large outlays for development, the cost last year of realizing \$1 in gold was \$1.08.

The year's output came from various workings on and between the 600 (vertical) and 6,600 levels. A total of 141,211 tons was delivered to the sorting plant, of which 32,011 tons was discarded as waste, leaving 109,200 tons crushed, with an average yield of \$7.98 per ton crushed, at an average cost of \$6.91 for operating and \$1.69 for development, making an aggregate cost of \$8.60 per ton and resulting in a loss of \$0.626 per ton. The yield per ton in 1924 was 30c. and the cost 69c. less than in 1923.

Of the total production of the year, 76.27 per cent was obtained in the mill by amalgamation and 23.73 per cent was recovered by cyanidation. It is estimated that the value lost in the tailings was about 33c. per ton crushed.

It was stated in the last annual report that consideration was being given to plans for the deeper exploration of the mine by means of a continuation of the vertical shaft for a distance of 2,000 ft. Before starting on this expensive undertaking, it seemed advisable to seek further confirmation of the belief that profitable orebodies might reasonably be expected to exist at great depth. Active explorations were therefore continued throughout the year, to the extent of 7,315 ft. In the lower levels the result of the work done was disappointing, inasmuch as no considerable body of ore was developed. The indications, however, are not without encouragement, and it is the opinion of the company's engineers, based on geological indications and deductions, that there is a reasonable expectation of developing a new mine above and below a plane approximately 2,000 ft. below the present bottom of the shaft.

At present the mine is practically without any developed ore resources and, as the only alternative to a discontinuance of operations, the board of directors, after long and careful consideration, though recognizing the hazard of the undertaking, has felt justified in authorizing the proposed deep development. The project calls for the extension of the vertical shaft for approximately 2,000 ft., the sinking of two incline shafts (a total distance for the two of 3,800 ft.), and the running of levels for say 2,500 ft. It is estimated that this work will take all of this and next year, and cost about \$700,000. During this period, with development the chief consideration, the operation of the mill may have to be reduced to one-half capacity, or less, and the production can scarcely be expected to do better than take care of milling and a part of the overhead expense.

Iron Cap Copper Co.

During the first quarter of 1925 the production of the Iron Cap Copper Co. was 1,489,618 lb. of copper, 41,178 oz. of silver, and 29 oz. of gold. Income for the quarter was \$186,479.43, and expenses amounted to 133,934.05, showing a gain of \$52,545.38.

The profit shown, before depreciation and depletion, is pleasing by comparison with the 1924 results. It does not now appear probable that this rate can be maintained.

Tharsis Sulphur & Copper, Ltd.

The net profits of the Tharsis Sulphur & Copper, Ltd., for 1924 amounted to £97,950, compared with £97,173 for the previous year. A dividend of 4s. per share, less tax (the

same as for 1923) has been announced, and after writing off £18,804, the carry forward is £31,300 (against £30,225). There was a considerable increase in the output from the Calanas mine, production being 360,403 tons.

Rio Tinto Co., Ltd.

Rio Tinto's report for 1924 states that after deducting taxes, cost of administration, hospitals, pensions, and other expenses from the profit on sales of produce and other revenue credits there remains a balance on the revenue account of £1,051,332 11s. 8d. The balance brought forward from 1923 was £440,130 12s. 11d., making a total of £1,491,463 4s. 7d. Total distribution of dividends for the year was £1,018,750, leaving a balance to be carried forward in revenue account of £472,713 4s. 7d.

Work on the mines has been steadily carried on throughout the year under satisfactory conditions. The amount of ores mined was 2,439,000 tons in 1924, as compared with 2,012,000 tons in 1923 and 1,705,000 tons in 1922. The present rate of output can be maintained without undue strain, and, indeed, increased if there is a heightened demand.

There has also been an appreciable reduction in the cost of production.

Total of May Dividends Shows No Change From Preceding Quarter

The following dividends were paid by American mining and metallurgical companies during May:

Companies in the United States	Situation	Per Share	Total
American Smelting & Refining	Various	1 50 Q	\$914,970
Anaconda Copper Mining	Various	0 75 Q	2,250,000
Bunker Hill & Sullivan, l, s, z	Idaho	0 75 M	245,250
Chief Consolidated, l, s, z	Utah	0 10 I	100,000
Colorado Fuel & Iron, pfd.	Various	2 00 Q	400,000
Copper Range, c.	Mich.	1 00 A	394,727
General Development	Various	0 25 Q	30,000
Homestake Mining, g.	S. D.	0 50 M	125,580
International Nickel, pfd., n, c.	W. Va., Ont.	1 50 Q	133,689
Mammoth Mining, l, s.	Utah	0 10 I	40,000
Miami Copper	Ariz.	0 25 Q	186,778
New Cornelia Copper	Ariz.	0 25 Q	450,000
New Jersey Zinc	Various	2 00 Q	909,328
St. Mary's Mineral Land, c.	Mich.	3 00 A	480,000
U. S. Steel, pfd.	Various	1 75 Q	6,304,919
United Verde Extension, c.	Ariz.	0 50 Q	525,000
Companies in other countries			
Amparo Mining, g, s.	Jalisco	0 02 Q	40,000
Asbestos Corporation	Quebec	1 00 Q	30,000
Cerro de Pasco, c, s.	Peru	1 00 Q	1,122,662
Hollinger Consolidated Gold	Ont.	0 05 4 weeks	246,000
Lucky Tiger-Combination Gold	Sonora	0 07 M	50,074
Total			\$14,618,977

l, lead; s, silver; z, zinc; c, copper; g, gold; n, nickel; Q, quarterly; M, monthly; I, irregularly; A, annually.

Dividends paid in May were almost exactly equal to those paid for the preceding quarter, in February, and about \$2,700,000 greater than were distributed in May, 1924. Chief Consolidated again entered the dividend list with the same amount as was paid a year ago when the last distribution was made. Copper Range and St. Mary's Mineral Land, two Michigan producers, also paid the same amount as in May, 1924, and until conditions change, are apparently on an annual basis. Mammoth Mining reflects profits from recently discovered ore by sending checks to stockholders for the first time since 1917, several Irish dividends having been declared in the meantime.

Miami has reduced its dividend from 50c. to 25c., the stock having broken badly before that happened. Apparently stockholders were very slow to realize the limited amount of ore reserves of present milling grade. A leaching plant will be built to treat the lower-grade material so the company should operate for many years yet. Asbestos Corporation dropped back to its old dividend rate of \$1 per share on the common.

Hollinger is to go on an 8c. basis soon, according to the president, thus making its distribution \$393,600 every four weeks, or \$5,116,800 annually. This will be no mean lump of sugar, but it will still be surpassed by the New Modderfontein on the Rand, which rewarded stockholders to the extent of £1,400,000 last year. New Modder, however, is expected to last only about fourteen years longer, whereas Hollinger will last forever so far as now known.

Gladstone Mountain may be continuing its modest dividend of \$6,609 paid in March and April, but if so, has failed to advise us of the fact. Unofficial reports also credit the "West Comstock Gold Mines" with a dividend of 4 per cent in May.

Current Prices of Mine Materials and Supplies

Rise and Fall of the Market

Aside from some firmness in track supplies, other than railroad spikes, there is general price weakness in steel sheets, structural shapes, cast-iron pipe, lumber and wire nails. There were few other changes in prices of mine materials and supplies during the month. Cost of mine construction is exactly the same as it was during the last week in April.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
Blue Annealed	\$2.40@2.50	\$3.90	\$3.80	\$4.20	\$3.89
No. 10					
Black	3.15@3.50	4.80	4.50	5.25	4.35
No. 28					
Galvanized	4.25@4.60	5.80	5.50	6.25	5.35
No. 28					

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	—Pittsburgh—			
	Current	Year Ago	Birmingham	Chicago
Standard bessemer rails	\$43.00	\$43.00	\$43.00	\$43.00
Standard openhearth rails	43.00	43.00	43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	—Pittsburgh—					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Bir- ming- ham
Standard spikes, 1/2-in. and larger	\$2.80	\$3.00	\$3.55	\$3.65	\$4.35	\$2.90
Track bolts	3.90@4.25	4.00@4.25	4.55	4.65	5.85	3.90
Standard section angle bars	2.75	2.75	3.30	3.50	4.00	3.85

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pitts- burgh, Mill	Bir- ming- ham Mill	New York	Dallas	St. Louis	Chi- cago	San Fran- cisco
Beams, 3 to 15 in.	\$1.90@2.10	\$2.05	\$3.34	\$4.15	\$3.25	\$3.10	\$3.30
Channel, 3 to 15 in.	1.90@2.10	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 6 in., 1/2 in. thick	1.90@2.10	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.10	2.10	3.34	4.15	3.25	3.10	3.30
Plates	1.90@2.10	2.00	3.34	4.15	3.25	3.10	3.30

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7 1/2%
Round strand iron and iron tiller	5%
Flow steel round strand rope	3 1/2%
Special steel round strand rope	30%
Galvanized iron rigging and guy rope	+12 1/2%

Drill Rod (from list)

	New York	Cleveland	Chicago
	60%	55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
BUTT WELD	1 to 3	62	50 1/2	1 to 1 1/2	30	13
LAP WELD	2 1/2 to 6	59	47 1/2	3 to 6	28	13

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	—Black—		
	New York	Chicago	St. Louis
3 1/2 to 6 in. lap welded	48%	56 1/2%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	—New York—		Bir- ming- ham	Chi- cago	St. Louis	San Fran- cisco
	Current	One Year Ago				
6 in. and over	\$50.60-51.60	\$61.60-63.60	\$48.20-50.20	\$46.70-48.20	\$47.60	\$52.00

NUTS—Semi-finished, 1/2 x 1/2-in., 2c. each. Discount 70% for 3/8-in. and smaller; 65% for 1/2-in. and larger. Case hardened, 6c. each, less 50%.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	—New York—		Chi- cago	Phi- la- del- phia	St. Louis	San Fran- cisco	Perth Amboy N. J. Factory
	Current	One Year Ago					
4 x 12 x 12	\$0.1162	\$0.1162	\$0.06	\$0.1325	\$0.08	\$0.108	
6 x 12 x 12	.1743	.1743	.0825		.108	.156	\$0.252*
8 x 12 x 12	.2179	.2179	.1125	.25	.150	.244	.312*

* 10x12x12; † 12x12x12

MACHINE BOLTS—1/2 x 1/2-in., per 100, \$1.70. Discount at New York warehouses on all sizes up to 1 x 3/8-in., 40%.

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers at yards in San Francisco. To contractors, \$2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	\$26.00	\$27.00	\$28.00	\$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, \$5 additional.

	—New York—		—Chicago—	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22- 24 Ft.
3x4 to 8x8	\$46.00	\$47.00	\$29.00	\$30.00
3x10 to 10x10	50.00	51.00	33.00	34.00
3x12 to 12x12	55.00	56.00	39.00	40.00

Other Cities

	—8 x 8-In. x 20 Ft. and Under—				—12 x 12-In. 20 Ft. and Under	
	Pine	Fir*	Hemlock	Spruce	Pine	Fir*
Boston	\$51.00	\$48.00†	\$50.00	\$50.00	\$61.00	\$58.00†
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Denver	33.75	33.75	33.75	33.75	34.75	34.75
Minneapolis	43.00	39.75	36.00		44.50	39.75
Kansas City	42.00	40.75			53.60	41.75
Birmingham	32.00				34.00	

* Douglas fir. † Prime.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Mon- treal
Wire	\$2.75@2.85	\$3.25	\$4.00	\$4.25	\$3.33	\$4.95
Cut	2.90		5.25	5.00	3.58	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots without bags. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	\$2.50@2.60	\$2.50@2.60	\$2.50@2.60
Chicago, f.o.b.	2.20	2.20	2.20
Cleveland, f.o.b.	2.39	2.39	2.39

LIME—Warehouse prices:

	Hydrated, per Ton	Lump, per Barrel	280-lb. net
	Finishing	Common	Finishing
New York	\$18.20	\$12.00	\$3.50
San Francisco			\$2.50@2.75
			(180-lb. net) 1.60

LINSEED OIL—These prices are per gallon:

	—New York—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago
Raw in barrel (5 bbl. lots)	\$1.09	\$0.95	\$1.26	\$0.94

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	—Dry—		—In Oil—	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	15.75	15.00	17.25	16.50
White	15.75	15.00	15.75	15.00

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2 1/2-in. coupled, single jacket		56c per ft.
Air—Best Grade		
1/2-in., per ft.	3 ply \$0.33	4 ply \$0.40
First grade	40%	Second grade 40-5% Third grade 40-10%

RUBBER BELTING—List price 6-in., 6 ply, \$1.83 per lin. ft. for rubber transmission belting.

Best grade	50-5%	Second grade	50-10-5%
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LEATHER BELTING—List price, 24c. per lin. ft. per inch of width for single grade at New York warehouses:

	Grade	Discount from list
Medium		30-10%
Heavy		20-5%

RAWHIDE LACING { For cut, best grade, 45-50%, 2nd grade, 55%.
{ For laces in sides, best, 41c. per sq. ft.; 2nd, 37c.
{ Semi-tanned: cut, 45-50%; sides, 41c. per sq. ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, 1/2 in.	\$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., 1/2-in. and larger, 1,200-ft. coils.

Atlanta	\$0.26	New Orleans	\$0.26
New York	.27	Seattle	.17
Chicago	.21 1/2	San Francisco	.26

EXPLOSIVES—Prices per pound of dynamite in small lots:

	—Gelatin—	
	40%	60%
New York	\$0.27	\$0.295
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.22	.245
New Orleans	.233	.26
San Francisco	.1625	.1925

FLOTATION OIL—

Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York, carload lots, per gal.	\$0.35
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CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	\$0.98 1/2
Litharge, f.o.b. New York, kegs, per 100 lb.	15.75
Sodium cyanide, 220 lb. single case lots, f.o.b. w. rks, per lb.	.18@.22

Mining Stocks—Week Ended May 23, 1925

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Anaconda	New York	39 1/2	37 1/2	38 1/2	Ap. 16, My. 23, 0.75
Arcadian Consol.	Boston	1 1/2	1 1/2	1 1/2	
Ariz. Com'l.	Boston	10 1/2	10	10 1/2	Ja. 19, Ja. 31 SA 0.50
Calaveras	N. Y. Curb				
Calumet & Arizona	New York	50 1/2	48 1/2	49	Jan. 15, Jan. 22 Q 0.50
Calumet & Hecla	Boston	13 1/2	12 1/2	13	Ja. 30, Mh. 4 0.50
Canario Copper	N. Y. Curb	5 1/2	5 1/4	5 1/2	
Cerro de Pasco	New York	50 1/2	49	50	Ap. 23 My. 1, Q 1.00
Chile Copper	New York	34	33	34	Jan. 3, Jan. 29, Q 0.62 1/2
Chino	New York	22 1/2	21 1/2	22 1/2	Sept., 1920 0.37 1/2
Con. Coppermines	N. Y. Curb	3	2 1/2	3	
Copper Range	Boston	21 1/2	20 1/2	20 1/2	Ap. 9, My. 4 1.00
Crystal Copper	Boston Curb	*58	*54	*58	
East Butte	Boston	3 1/2	3 1/4	3 1/2	Dec., 1919 0.50
First National	Boston Curb	*28	*23	*28	Feb., 1919 0.15
Franklin	Boston	*65	*65	*65	
Granby Consol.	New York	16	15 1/2	15 1/2	May, 1919 1.25
Greene-Cannanea	New York	13 1/2	13 1/4	13 1/2	Nov., 1920 0.50
Hancock	Boston				
Howe Sound, new r. t. e.	N. Y. Curb	17 1/2	16 1/2	17 1/2	April, 1924 0.50
Inspiration Consol.	New York	25 1/2	24	24 1/2	Jan., 1924 Q 0.05
Iron Cap.	Boston Curb	1 1/2	1 1/4	1 1/2	May, 1923 0.15
Isle Royale	Boston	13 1/2	12 1/2	13 1/2	Sept., 1923 0.50
Jerome Verde Dev.	N. Y. Curb	1 1/2	1 1/4	1 1/2	
Kennecott	New York	51 1/2	49 1/2	51	Jan. 5, Jy. 1, Q 0.75
Lake Copper	Boston	1 1/2	1 1/4	1 1/2	Jan. 1, Jan. 15 Q 0.50
Magma Copper	New York	43 1/2	40 1/2	42	Jan. 15, Jy. 15, 0.75
Mass Valley	N. Y. Curb	1 1/2	1 1/4	1 1/2	
Mass Consolidated	Boston	*45	*41	*41	Nov., 1917 1.00
Miami Copper	New York	10 1/2	9 1/2	9 1/2	My. 1, My. 15 Q 0.25
Mohawk	Boston	29	28	28	My. 2, Jan. 2 1.00
Mother Lode Coa.	New York	7 1/2	7	7 1/2	Jan. 12, Jan. 30 0.37 1/2
Nevada Consol.	New York	13 1/2	12 1/2	13 1/2	Sept., 1920 0.25
New Cornelia	Boston	19 1/2	19	19 1/2	My. 8, My. 25 Q 0.25
North Butte	Boston	1 1/2	1	1 1/2	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	*94	*85	*90	No. 14, De. 2 0.05
Old Dominion	Boston	19 1/2	19	19	Dec., 1918 1.00
Phelps Dodge	Open Mar.	110 1/2	98	98	Mh. 20, Ap. 2 Q 1.00
Quincy	Boston	24 1/2	22	22	Mar., 1920 1.00
Ray Consolidated	New York	13 1/2	12 1/2	13 1/2	Dec., 1920 0.25
Ray Hercules	N. Y. Curb				
St. Mary's Min. Ld.	Boston	33	31 1/2	32	Ap. 20, My. 20, 3.00
Seneca Copper	New York				
Shannon	Boston	*60	*55	*60	Nov., 1917 0.25
Shattuck Arizona	New York	6 1/2	6	6	Jan., 1920 0.25
Superior & Boston	Boston	1 1/2	1 1/4	1 1/2	
Tenn. C. & C.	New York	11 1/2	10 1/2	10 1/2	De. 31, Ja. 15, Q 0.25
United Verde Ex.	N. Y. Curb	25	23 1/2	25	Ap. 3, My. 1 0.50
Utah Copper	New York	90	87	90	Mh. 20, Mh. 31, Q 1.00
Utah Metal & T.	Boston	*56	*50	*55	Dec., 1917 0.30
Victoria	Boston				
Walker Mining	Salt Lake	2.65	2.47 1/2	2.47 1/2	
NICKEL-COPPER					
Internat. Nickel	New York	29 1/2	28 1/2	28 1/2	March, 1919 0.50
Internat. Nickel pfd.	New York			97 1/2	Ap. 16, My. 1, Q 1.50
LEAD					
Carnegie Lead & Zinc	Pittsburgh	5 1/2	5 1/4	5 1/2	
Gladstone M. M. Co.	Spokane	*28	*25	*28	Ap. 1925 0.00 1/2
National Lead	New York	157 1/2	149 1/2	155 1/2	Jan. 12, Jan. 30, Q 2.00
National Lead pfd.	New York	118	118	118	My. 22, Jan. 15 Q 1.75
St. Joseph Lead	New York	52 1/2	48 1/2	50 1/2	Mh. 5, Mh. 20 0.50
ZINC					
Am. Z. L. & S.	New York	7 1/2	7 1/4	7 1/2	May, 1920 1.00
Am. Z. L. & S. pfd.	New York	27	26	27	Nov., 1920 1.50
Butte C. & Z.	New York	6	5 1/2	5 1/2	De. 10, De. 24 0.50
Butte & Superior	New York	11 1/2	10 1/2	10 1/2	Mh. 19, Mh. 31 0.50
Callahan Zn-Ld.	New York	3 1/2	2 1/2	3	Dec., 1920 0.50
New Jersey Zn	N. Y. Curb	186 1/2	181	186 1/2	Ap. 20, My. 9 2.00
United Zinc	N. Y. Curb				
Yellow Pine	Los Angeles	*70 1/2	*69 1/2	*70 1/2	De. 10, De. 15 Q 0.04
GOLD					
Alaska Juneau	New York	1 1/2	1 1/4	1 1/2	
Argonaut	Toronto	*27	*25 1/2	*26	
Barry-Hollinger	Toronto	*49 1/2	*45 1/2	*49	
Carson Hill	Boston				
Consol. W. Dome L.	Toronto	*14	*13	*13 1/2	
Creoson Consol. G.	N. Y. Curb	3 1/2	3 1/4	3 1/2	Mh. 31, Ap. 10 Q 0.10
Crown Reserve	Toronto	*28	*27 1/2	*27 1/2	Jan. 1917 0.05
Dome Mines	New York	13 1/2	13 1/4	13 1/2	Mh. 31, Ap. 20, Q 0.50
Golden Cycle	Colo. Springs	1.42	1.42	1.42	Dec. 11, 1924 0.03
Hollinger Consol.	Toronto	15.10	14.80	14.95	Jan. 1, Jan. 17, 1.06
Homestake Mining	New York	45 1/2	44 1/2	45	My. 2, My. 20 M. 0.50
Jib. Cons. l.	N. Y. Curb				
Kirkland Lake	Toronto	*40 1/2	*39	*40	
Lake Shore	Toronto	5.76	5.70	5.71	Mh. 2, Mh. 16, 0.05
McIntyre-Porcupine	New York	17 1/2	17 1/4	17 1/2	My. 1, Jan. 1, 0.25
Newray	Toronto	*19 1/2	*19	*19	
Night Hawk Pen.	Toronto	*25	*24 1/2	*24 1/2	
Portland	Colo. Springs				Oct., 1920 0.01
Rand Mines	New York	39 1/2	37	37	Fe. 17, Fe. 25 1.79
Teck-Hughes	Toronto	1.36	1.31	1.35	
Tom Reed	Los Angeles	*51 1/2	*43 1/2	*43 1/2	Dec., 1919 0.02
Tough-Oakes	Toronto	*25	*22 1/2	*24 1/2	
United Eastern	N. Y. Curb	*50	*45	*50	July, 1924 0.05
Vipond Cons.	Toronto	1.13	1.11	1.12	
Wright-Hargreaves	Toronto	4.40	4.25	4.30	Mh. 16, Ap. 1, QX 0.05
GOLD AND SILVER					
Black Oak	N. Y. Curb			*81	
Con. Cortez	N. Y. Curb	*9	*9	*9	
Con. Virginia	San Francisco	6	5 1/2	5 1/2	
Continental Mines	N. Y. Curb				
Dolores Esperanza	N. Y. Curb	*55	*50	*55	July, 1923 0.05
Premier Gold	N. Y. Curb	2 1/2	2 1/4	2 1/2	Mh. 23, Ap. 3, 0.08
Tonopah Belmont	N. Y. Curb	*66	*66	*66	Mh. 15, Ap. 1 0.05
Tonopah Divide	N. Y. Curb				Oct., 1923 0.10
Tonopah Extension	N. Y. Curb	2	1 1/2	2	Mh. 11, Ap. 1, Q 0.05
Tonopah Mining	N. Y. Curb	4	3 1/2	3 1/2	Mh. 31, Ap. 21, 0.07 1/2
Unity Gold	N. Y. Curb	*80	*52	*80	
West End Consol.	N. Y. Curb				Mar., 1923 0.05
Yukon Gold	N. Y. Curb	*50	*50	*50	June, 1918 0.02

Stock	Exch.	High	Low	Last	Last Div.
SILVER					
Alvarado	Boston Curb				*50 Oct. 1920 0.50
Beaver Consol.	Toronto	*29 1/2	*28 1/2	*29	May, 1920 0.03
Castle-Trethewey	Toronto	*77 1/2	*75	*75 1/2	
Coniagas	Toronto	1.55	1.50	1.50	May, 1924 0.12 1/2
Keeley	Toronto	1.91	1.88	1.90	Mh. 1, Mh. 15 SA 0.12
Kerr Lake	N. Y. Curb	1 1/2	1 1/4	1 1/2	Ap. 1, Ap. 15, Q 0.12 1/2
La Rose	Toronto	*50 1/2	*47	*49 1/2	Apr., 1922 0.10 1/2
Lorrain Trout Lake	Toronto	1.08	1.05	1.05	Ap. 15, 25 0.05
McKinley-Dar-Sav.	Toronto	*29 1/2	*29 1/2	*29	Oct., 1920 0.03
Mining Corp. Can.	Toronto	2.67	2.45	2.55	Sept., 1919 0.12 1/2
Nipissing	N. Y. Curb	5 1/2	4 1/2	5	Mh. 31, Ap. 21 0.15
Ontario Silver	New York	6 1/2	6	6 1/2	Jan., 1919 0.50
Temiskaming	Toronto	*18	*17	*17	Jan., 1920 0.40
SILVER-LEAD					
Ahumada	New York	11 1/2	10 1/2	11 1/2	Jan. 15, Jy. 2, Q 0.07 1/2
Bingham Mines	Boston	32 1/2	30 1/2	31 1/2	Jan. 20, Jan. 30 Q 0.50
Cardiff M. & M.	Salt Lake	1.42 1/2	1.25	1.35	De. 16, No. 18 0.10
Chief Consol.	Salt Lake			3.65	Ap. 10, My. 1 0.10
Columbus Rexall	Salt Lake	*12 1/2	*10	*10	Aug., 1923 0.05
Eruption	Boston Curb	3 1/2	3	3 1/2	Jan. 15, Jy. 2, Q 0.07 1/2
Federal M. & S.	New York	17	17	17	Fe. 26, Mh. 15 Q 1.75
Federal M. & S. pfd.	New York	56 1/2	54	54	My. 25, Jan. 15, Q 1.75
Hecla Mining	N. Y. Curb	14 1/2	14 1/4	14 1/2	Jan. 15, Jy. 1 Q 0.75
Iron Blossom Con.	Salt Lake			*39	Oct. 25, 1924 0.01 1/2
Iron King Mining	Salt Lake	*76	*56	*75	
Keystone Mining	Salt Lake	*78	*70	*77	
Mammoth Mining	Salt Lake	2.50	2.30	2.50	My. 15 Mv. 25 0.10
Marsh Mines	N. Y. Curb			*4	June, 1921 0.02 1/2
Park City	Salt Lake	4.50	4.35	4.40	Jan. 15, Jy. 1 0.15
Park Utah	Salt Lake	4.50	4.25	4.25	April, 1924 0.15
Prince Consol.	Salt Lake	*24	*23	*23	
Silver King Coal	Salt Lake	7.00	6.85	6.95	Mh. 20, Ap. 1, Q 0.20
Silversmith	Spokane	*21 1/2	*20	*21 1/2	Ap. 1, Ap. 10 0.01
Tamarack-Custer	Spokane	*75	*72	*75	Sept., 1924 0.25
Tintic Standard	Salt Lake	9.85	9.60	9.85	Mh. 23, Mh. 30 0.40
Utah-Apex	Boston	6 1/2	6 1/4	6 1/2	Ap. 5, Ap. 15, 0.35
Western Utah Copper	N. Y. Curb			*14	
IRON					
Bethlehem Steel	New York	42	39 1/2	41 1/2	July, 1924 1.25
Char. Iron	Detroit			*20	
Char. Iron pfd.	Detroit			*85	
Colorado Fuel & Iron	New York	40 1/2	39	39	May, 1921 0.75
Gt. North'n Iron Ore	New York	29 1/2	28 1/2	28 1/2	Ap. 11, Ap. 30 1.00
Inland Steel	New York	41 1/2	39 1/2	41	My. 15, Jan. 1 0.62 1/2
Mesabi Iron	N. Y. Curb			2 1/2	
Replage Steel	New York	15 1/2	14 1/2	15	
Republic I. & S.	New York	48	45	48	May, 1921 1.50
Republic I. & S. pfd.	New York	87	87	87	Jan. 17, Jy. 1, Q 1.75
Sloss-Sheffield S. & I.	New York	89 1/2	85 1/2	88	Jan. 10, Jan. 20 Q 1.50
Steel-Steel S. & I. pfd.	New York	94 1/2	93 1/2	94 1/2	Jan. 20, Jy. 1, Q 1.75
U. S. Steel	New York	120 1/2	116 1/2	118 1/2	Jan. 1, Jan. 29, QX 1.75
U. S. Steel pfd.	New York	124 1/2	122 1/2	124 1/2	My. 5, My. 29, Q 1.75
Virginia I. C. & C.	New York			35	Jan., 1924 1.50
Virginia I.C. & C. pfd.	New York	97	97	97	De. 13, Jan. 2, SA 2.50
VANADIUM					
Vanadium Corp.	New York	30 1/2	26 1/2	30	Jan., 1921 1.00
ASBESTOS					
Asbestos Corp.	Montreal	81	73	80	My. 1, My. 15 Q 1.00
Asbestos Corp., pfd.	Montreal	111	104	111	Ap. 1, Ap. 15, Q 1.50
SULPHUR					
Freeport Texas	New York	16 1/2	15	15 1/2	Nov., 1919 1.00
Texas Gulf	New York	112	106	109 1/2	Jan. 1, Jan. 15, Q 1.75
DIAMONDS					
De Beers Consol.	New York			20 1/2	Ja. 6, Fe. 2 0.95
PLATINUM					
So. Am. Gold & P.	N. Y. Curb	2 1/2	2 1/4	2 1/2	
MINING, SMELTING AND REFINING					